SCIENTIFIC AMERICAN

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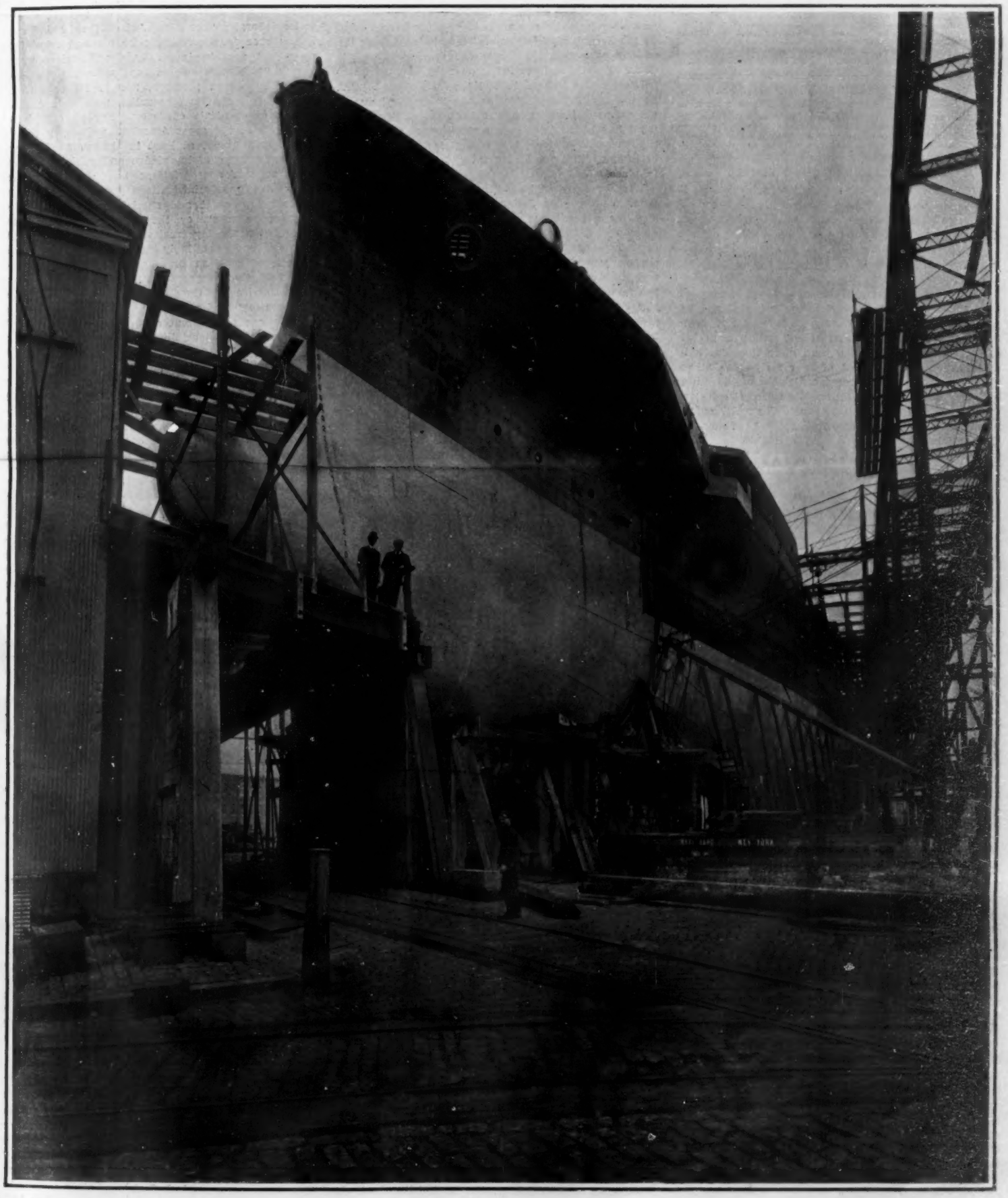

The great length, 521 feet 6 inches, of the ship made it necessary to build the ram bow above one of the navy yard streets and railroad tracks, upon a special steel-and-timber bridge as shown above. The launching weight of the huge ship is 9,000 tons; at sea she will weigh 21,825 tons.

Photograph by E. Mueller

THE "FLORIDA" READY FOR LAUNCHING AT THE BROOKLYN NAVY YARD.—[See page 374.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, MAY 7th, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE AEROPLANE AND THE DIRIGIBLE.

IN all the history of mechanical achievement it would be difficult to find a parallel to the combination of intelligence and audacity with which a few men, in as few years, have lifted the art of flying from the dreamland of the impractical enthusiast into the world of brilliant accomplishment. It was not so very long since that a scientist of world-wide reputation attempted to prove that, because of certain fundamental principles, the art of flight by means of heavier-than-air machines was not commercially practicable. Nevertheless, within a period of considerably less than a year, more than one aviator has flown at a speed of over forty-seven miles an hour; another has covered a distance of 144 miles in a continuous flight of four and a quarter hours; a third has flown across the English Channel; and a fourth, Paulhan, the most distinguished aviator of them all, has soared nearly a mile into the air, and finally has surpassed even that feat by flying from London to Manchester, covering a distance of 186 miles, with but one stop for fuel, at an average speed of over forty miles an hour.

The significance of this really wonderful race between Paulhan, the Frenchman, and White, the Englishman, is apparent only when we consider some of the details which have been cabled to this side of the Atlantic. That Paulhan should have won the $50,000 prize in such superb style, at the very first trial, is a tribute both to his own skill in manipulation, and to the excellence of the Farman biplane with which the race was won; but to appreciate the full significance of the race, we must remember that both contestants, and particularly White, flew for a considerable stretch of the journey at night time, and, what is of even more importance, that they did not hesitate to make both the ascent and the descent in the darkness. No stronger evidence than this could be afforded that the aeroplane is an instrument of precision, which can be relied upon to answer with certainty to the controlling hand of the operator.

There is something strongly suggestive of bird-flight in the description of the manner in which one of the contestants, after leaving the ground, swept through the air in a wide circle in order to get the lay of the land and the proper direction of flight, or to pick up again a course from which he had been driven by the wind. But certainly the most difficult feat of all was that of making a landing at night time, in a locality with which the aviator was quite unacquainted, and where he had to make a wide detour, looking for a suitable stretch of unobstructed surface on which to alight.

Last year, in commenting upon the status of the art of flying, we pointed out that the one last obstacle to be overcome, before flight could be reckoned among the practical achievements, was that of successful starting and alighting upon the average surface which would be encountered in cross-country flying, and performing these feats with certainty in a breeze of ordinary strength. The London-to-Manchester race would certainly seem to prove that this important stage in the development of human flight has been reached and successfully passed.

In strong contrast to these achievements of the aeroplane is the series of disasters to airships, culminating in the wrecking of the huge dirigible "Zeppelin II.," which have occurred during the last few weeks. Although the dirigible has proved to be perfectly stable and to possess the ability to fight its way against winds of considerable strength, the late disasters, and notably the wrecking of the "Zeppelin," emphasize the fact that, whenever these huge and delicate fabrics approach, or are in contact with, the ground, they are in imminent danger of destruction. In this respect, they are in the same class as the ocean steamship, whose captain cares little what winds may blow, when once he is well clear of the land with everywhere deep water below his keel; but whose anxieties increase in proportion as the water shoals, and the vessel again approaches the coast line.

The peril of the dirigible lies in its huge bulk and the great area which it exposes to the pressure of the wind. These elements, it is true, are not a source of so much danger when once the craft is well clear of the earth and has abundance of what the navigator would call "sea room" in which to maneuver; but when it comes to the question of making a landing, and so long as the airship is upon the surface of the ground in an unprotected position, as she must needs frequently be, the dangers of disablement, and even of complete disaster, are ever present. We all remember how the accumulated pressure of the wind on the French airship "Patrie" tore it loose from the soldiers who were frantically endeavoring to hold it down to earth, and carried it over the English Channel and across Ireland, to be lost in the ocean beyond. So too, in this later disaster, the "Zeppelin," during an enforced landing, was caught in an increasing wind in which it was only a question of time before the pressure proved too strong for the company of infantry that was endeavoring to hold the airship in place.

Wind pressure on large structures runs up to enormous figures. The designers of bridges make provision for a maximum pressure of thirty pounds on every square foot of surface. If we apply this unit of pressure to the "Zeppelin," we find that on a plane surface represented by the total length of 446 feet and the diameter of about 40 feet, plus the area of the cars, rudders, etc., the pressure would amount to about 250 tons; and if we admit that the effective pressure due to the circular shape of the gas bag would be only about one-half of this, there would still be a strain of 125 tons upon the guy ropes, etc., by which the machine was held in position.

If we include the Lake Constance disasters, this is the third or fourth wrecking of a Zeppelin dirigible by its being dashed to pieces in stormy weather after making a landing, and the moral is, that these ships of the air should remain as far as possible permanently afloat, tying up, when they wish to make a stop, to lofty steel mooring towers, which they must approach end on, and to which they must make fast by cables from the bow. This, we believe, is the plan which Zeppelin himself proposes to follow; and it would certainly seem to be the only arrangement that offers security against absolute shipwreck.

THE DECLINE OF THE UNIVERSITY IN SCIENTIFIC RESEARCH.

SO many valuable discoveries and researches are now due to scientific institutions under government control or founded and supported by private munificence for specific purposes that the question arises: Is it not to such agencies rather than to the universities and colleges that we must look for the most active progress in future original scientific investigation?

Not only are these institutions for special research freed from the duty and cares of teaching, but, what is of greater importance, their organization and equipment are generally far more efficient. Every possible assistance is rendered to the individual investigator, and he in turn is carefully selected for his proficiency and promise, and with ample facilities at his disposal and supplied with an adequate salary, he is expected to work systematically along certain definite lines with entire freedom from financial or administrative concern.

At the head of these institutions there are usually directors who are men not only of eminence in their special science, but competent to organize and conduct campaigns of scientific research, which may include a number of workers often in widely different fields, yet all engaged in studies merging into one definite scheme. Each worker receives full credit for his particular contribution, and the solution of great and complex problems is undertaken with all the efficiency of organization and co-operation characteristic of the best and most modern industrial and commercial practice. Yet there is no sacrifice of the true scientific spirit, and the only elements of the commercial world that are applied are economy of effort and resource, efficiency of organization, and adequate capital and plant to push to a satisfactory outcome any particular project or class of investigation.

These conditions have attracted many investigators of reputation, and in such scientific establishments as the various laboratories of the Carnegie Institution of Washington, the Rockefeller Institute for Medical Research, and the research laboratories of manufacturers' associations and large corporations, not to mention those conducted under government auspices, much scientific work of the highest grade is done. One might refer to various foundations for the study of tuberculosis, cancer, and tropical diseases, to national physical and testing laboratories and bureaus of weights and measures, to astronomical observatories and biological stations, to museums and meteorological observatories. In nearly every case there would be found an interesting record of scientific activity. This work is of an original character and is often important both to science and in its application to the everyday affairs of humanity.

With this ever increasing efficiency on the part of special research institutions, we are brought face to face with the fact that no longer are American colleges and universities with their various scientific schools and laboratories in as good a position to forward scientific research as of old. In a few cases there are special endowments which support observatories, laboratories or clinics, where there is but slight interference from governing boards and administrations, but, speaking generally, the American university is not always able to supply the material facilities for modern research, nor is its organization such as to make its prosecution possible under conditions of economic efficiency. For so extended is the work of the great American university that its departments cover, at least in theory, an inconceivably wide range of knowledge and subjects, and for their support appropriations none too large must be granted by administrations and governing boards without any exact and special knowledge of their comparative needs or the merits of their work. Where even the lay trustees of a special institution can pass understandingly on the plans, projects and budgets of such an organization, with its well defined field, the governors of a university, overwhelmed by the intricacy of the situation, as well as by its magnitude, usually adopt a policy of averaging their appropriations to different departments rather than of assuming the responsibility of passing on the merits or urgency of their work.

But important as are material support and facilities to modern research, this is by no means the only or most serious question; for the man of genius triumphs eventually over the difficulties due to their absence. So extended have American universities recently become, both in scope and number of students, that members of their faculties are compelled not merely to give an unduly large amount of instruction along lines once considered fundamental, but in addition to offer courses in special or allied branches involving no small amount of painstaking preparation. So keen is the competition on the intellectual side, and in the number of courses offered and in the desire for large registration, that an executive head of the university demands from his staff, as a condition of salary advance or promotion, the greatest possible amount of teaching, be it congenial or not. Under such conditions it is not difficult to see that the time and inclination for special investigation and research by a young scientist occupying a university chair may be seriously curtailed. Furthermore, so intricate is modern university mechanism and even minor administration, that from a professor there is required an ever-increasing amount of clerical labor in the compiling of statistical and other records, and information about students and departmental activities, according to the exactions of the educational machinery, which to-day is apt to imitate commercial forms rather than commercial efficiency and economy of effort. Thus, in the misunderstanding of the professor's function and misuse of his time, a partial explanation may be found for the relatively poor showing that American professors of science make in comparison with their European colleagues. This condition, university presidents and trustees in America tell us, can be remedied by the provision of great and further endowments for research chairs and laboratories; but it now seems an open question whether such funds are not more productive when applied to special institutions apart from educational machinery. It must not be understood that the training of young men for scientific research has experienced any slackening of effort in our universities and technical schools, for it is these men, stimulated as never before by their professors, who will bear forward the torch of scientific progress. Education and original discovery seem destined in the future to be carried on by totally distinct organizations.

That the silver area in northern Ontario is continually being widened is evidenced by the discovery of native metal about fifty miles west of Cochrane on the Grand Trunk Pacific. It is understood that the discovery was made in blasting out a railway cut. When the news reached Cochrane, sixty prospectors started out the next morning and this number is being constantly augmented by fresh arrivals.

AERONAUTICS.

Mr. A. L. Pfitzner has been making successful flights with his novel monoplane (which was illustrated in our issue of February 12th) of late in various places. On April 15th he made three successful short flights at the Buffalo Country Club, and in the fourth flight he ran across the field at a high rate of speed, rising to a height of ten or twelve feet, when a gust of wind struck the machine and drove it to the ground with great force. The aviator was bruised and badly shaken up, and his machine was more or less seriously damaged. Despite his accident, Mr. Pfitzner has demonstrated that his novel sliding wing tips work well.

Messrs. A. M. Herring and W. S. Burgess have been experimenting with the former's new biplane on Plum Island, opposite Newburyport, Mass. This new machine, which was illustrated in our issue of March 19th, has demonstrated that it can slide over the ground and rise from its single skid without the use of wheels. On April 17th, Mr. Herring made a short flight of about 250 yards. On the 21st he made three other flights, in the longest of which he covered about 300 yards at a height of fifteen feet. The next day Mr. Greeley S. Curtis, while flying the machine at an estimated height of thirty feet, lost control of it. The biplane descended and struck the ground head on, fortunately in a soft meadow. It was badly smashed, but the aviator was not injured.

While aviation advances by leaps and bounds, aerostation has had several serious setbacks of late. To begin with, on April 3rd the German balloon "Pommern," celebrated for having won the Bennett cup race in America in 1908, fell into the Baltic Sea and three of its four occupants—one, Herr Delbrück, a member of the Reichstag—were drowned. The next day Prof. Abegg, a well-known German chemist, was killed while making a landing; while on the 18th ultimo the balloon "Delitzsch" carrying four men burst during a thunder storm while at a height of several thousand feet, all its occupants being killed by the fall. It was at first supposed that the balloon was struck by lightning, but this was afterward found not to be the case. Emperor William, however, has had a thorough investigation made and is getting together all the facts regarding the igniting of the gas in balloons by atmospheric electricity.

As far as dirigible balloons are concerned, Germany, which for some time past has been in the lead with this form of air craft, has also suffered severely. After making various cruises in the vicinity of Cologne, the "Zeppelin II." "Gross II.," and "Parseval I." airships flew from that city to Homburg on April 22nd and were reviewed by Emperor William. As a gale sprang up, the airships were moored at Homburg over night. As strong winds continued, the "Gross II." (which is a non-rigid dirigible) was deflated and shipped back by rail. The "Parseval" and "Zeppelin II." attempted to make the return journey, but only the former was successful in accomplishing it. The "Zeppelin" lost gas and was forced to descend at Limburg, where it was moored again over night, and fully inflated in the morning. At noon a sudden squall of wind tore the huge dirigible from its moorings and it floated off without a crew. A half hour later it was driven to the ground at Weilburg. It fell beside a cliff and broke in two. The sudden demolishment of this, the principal airship of the German fleet, has shown how precarious is the existence of these leviathans of the air.

On April 21st Prof. John J. Montgomery, of Santa Clara College, Santa Clara, Cal., lectured before the Aeronautical Society in New York upon his aeroplane experiments. These were begun in 1883, and Prof. Montgomery met with no little success from the start. After first trying a flapping-wing machine, he next built a monoplane glider having wings 10 by 4½ feet in size, and patterned after the wings of a gull, i. e., with a downward curve in front. Upon running down hill with this first glider, he rose and glided 600 yards. He steered and maintained equilibrium by leaning his body to one side or the other. He next endeavored to secure better control, and to this end studied the birds closely. He was able to determine just how they warp their wings. Then he built several machines with warpable wings resembling a fly's wing in structure. He made scientific experiments upon the lifting power of curved surfaces; and he finally evolved a Langley-type warpable glider having curved surfaces and a *fixed vertical* tail (in conjunction with a movable horizontal tail) that worked splendidly, and that could be steered simply by warping the wings. This machine, piloted by Daniel Maloney, was cut loose from a balloon at heights of 1,000 to 3,000 feet, and the aviator was able to pick a landing place and alight wherever he pleased. Prof. Montgomery secured a U. S. patent (No. 831,173) on September 18th, 1906, and in view of his practical demonstration of steering *without the use of a vertical rudder*, it would seem that this rudder is not as essential as the Wright brothers claim.

ELECTRICITY.

The Subway Telephone Construction Company of Chicago has promised to provide that city with a complete automatic telephone system by the first of June next year. At first it will cover only the business district, but later will be extended to the residential sections.

Merchants in the South have awakened to the value of rural telephone lines, and are seeking to develop them, with a view to increasing their trade among the rural population. In certain sections they have made large contributions to aid the farmers in building their lines.

The Weather Bureau has arranged to give daily weather forecasts by telephone to farmers in Texas. At noon each day rural subscribers are called up, and the weather forecast is announced to all simultaneously. Subscribers in towns and cities can obtain the weather forecast at any time of the day after 11 A. M. by calling up central.

A writer in Physikalische Zeitschrift has been investigating the frequency of electrical oscillations when a condenser is discharged through a spark gap. He finds that this depends to a large extent on the nature of the electrodes. For instance, a discharge between copper and silver electrodes would give a longer wave length than a spark between magnesium electrodes, and he comes to the conclusion that magnesium is the most suitable metal for spark electrodes.

A new system of jointing lead cables has been developed in England. It consists in placing a thin ribbon of pure tin between the surfaces that are to be joined, and then heating them with a blow lamp. The surfaces in the presence of the tin melt at a lower temperature than normal, and thus they are soldered together. The tin ribbon is treated with a composition to prevent oxidation during heating. Another system of jointing consists in the application of a mold over the cable. A piece of tin ribbon is applied to the surfaces which are to be joined, and then molten lead is poured into the mold. The flow is so directed as not to burn through the lead sheathing of the cable.

The fourteen-year-old president of the Junior Wireless Club of America appeared before the Senate Committee on Commerce last week to protest against the bill introduced by Senator Depew for regulating wireless telegraphy. The young president gave a very forcible argument in favor of amateur wireless telegraph operators, pointing out the fact that if the bill were passed it would check the inventive genius of some forty thousand experimenters. He also called attention to the fact that it would be impossible to enforce the bill without a veritable army of expert wireless telegraph engineers. The junior wireless telegraphers claim that it is possible to cut out interference if the proper apparatus is used, and that the present attack on amateur wireless telegraphers is unwarranted.

The Third Avenue Railroad Company of New York tried out last winter a gasoline-electric car on its crosstown lines. Now another type of car is being tried, and a comparison will be made of the two. The new car is a reconstructed horse car provided with Gould storage batteries and a pair of five horsepower motors. The battery is placed under the seats of the car, and has a rating of 420 ampere-hours at 84 volts. It is made up of twenty-nine plates per cell, and there are forty-four cells at each side of the car. The gases that are generated by the battery are carried off by a ventilating system and exhaust under the rear platform. The car weighs only six tons fully loaded. It has been found to consume in actual service only 0.54 watt-hour per ton mile, while maintaining a speed of six miles per hour with nine stops per mile.

The steel hull of a vessel is rendered magnetic during construction by the hammering of the metal, and every steel vessel has to have its compass corrected to counteract its own magnetic lines of force. The magnetic influence is further complicated by the load carried by the vessel if this load is magnetic or capable of being magnetized. The ore-carrying vessels of the Great Lakes experience great difficulty on this account, and the United States Hydrographic Bureau is endeavoring to teach pilots and captains of vessels plying in this trade how to check their course by means of the pelorus. The pelorus is an instrument similar to the sun dial, being provided with a gnomon and a graduated arc on which a shadow of the gnomon is cast. The instrument is set in a north and south direction, as indicated by the compass, and then by noting the shadow on the graduated arc, it is possible to tell by comparison with tables, furnished by the government, just how far from the north and south position the gnomon really lies, thus showing the compass error.

SCIENCE.

Prof. Adams, of the Mount Wilson Observatory, has been making a spectroscopic study of Halley's comet. He finds the head to be surrounded by cyanogen gas and the tail be to composed of hydrocarbons.

Sir Ernest Shackelton received a gold medal from the Geographical Society of Philadelphia at a dinner given in his honor on April 22nd. Among those who spoke in praise of Sir Ernest's achievements were such famous Arctic explorers as Rear Admiral George Melville and Amos S. Bonsal.

In an article published in Light, Mr. Robert E. Livingston states that the first man to use gas in New York city was Mr. Samuel Legget, who lighted his house at No. 7 Cherry Street with it. The people kept at a respectful distance from the house, fearing an explosion. Newport, Rhode Island, and Baltimore, Md., soon followed New York.

Rev. George M. Zwack, S. J., secretary of the Philippine Weather Bureau, has prepared, at the request of the insular government, a paper on "The Return of Halley's Comet and Popular Apprehensions," for distribution throughout the islands, with the object of reassuring the natives, who, it is said, are already a prey to many wild rumors on this subject.

The American Philosophical Society of Philadelphia has decided to assist in the movement for an expedition for south pole exploration. The project was urged in 1909, when the following scientific societies united in an appeal to Congress: The American Academy of Arts and Sciences, American Geographical Society, California Academy of Sciences, New York Academy of Sciences, Franklin Institute, Geographical Society of Philadelphia, American Museum of Natural Sciences, Geological Society of America, Association of American Geographers, and the American Alpine Club.

In a lecture delivered before the Royal Society of Naples, Prof. A. Piutti called attention to the discovery by Palmieri in 1881 of a characteristic line of helium in the flame spectrum obtained by heating in a flame "an amorphous, buttery substance of a yellow color which was found as a sublimate on the edge of a fumarole near the mouth of Vesuvius." This is generally accepted as the first discovery of terrestrial helium, although Nasini and Andelini in 1906, on examining the flame spectrum of a large number of volcanic incrustations, failed to recognize the presence of helium in any of the specimens they examined under the condition described by Palmieri.

The Express of London claims that another word must be added to the dictionary of gardening. This is "Caloriculture," the name of an entirely new system of horticulture, which has recently been inaugurated, and bids fair not only to replace the form of intensive culture of the French school, but to revolutionize the present system of fruit and vegetable forcing. While it is nearly customary to look for extreme and favorable developments in the line of soil cultivation, through French means, to us in the United States, who have not the garden habit quite so strongly as obtains in France, it comes as a surprise that the inventor of the new method is a Briton, Dr. F. Alexander Barton, Fellow of the Royal Society.

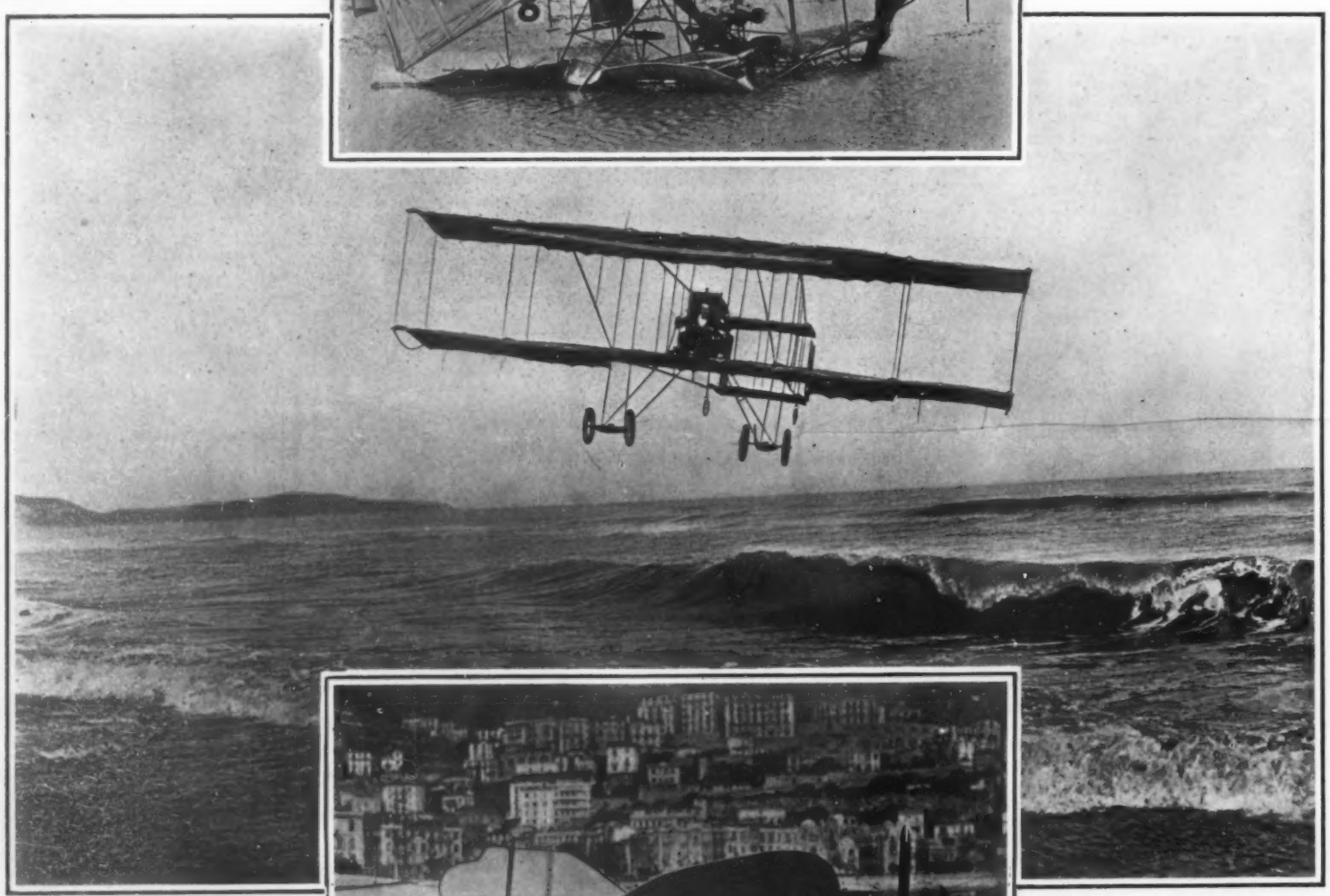
For the last year systematic excavations have been made at Ostia, the ancient harbor of Rome at the mouth of the Tiber. The ruins of a large city, built probably by Hadrian over the old republican town, have been uncovered. Archæologists consider the discoveries as important as those of Pompeii. Heretofore it has been believed that Ostia was founded by Ancus Martius, the fourth King of Rome, that it was destroyed by Marius during the civil wars, rebuilt during the republic, sank into insignificance, and was buried in the sand and deposited in the Tiber when Trajan built the new port and city of Portus. Instead of this it is now certain that Ostia not only continued to flourish under Hadrian, but that the old level was raised six feet and that the republican town served as the foundation for a model city with rectangular wide streets, temples, fora and squares.

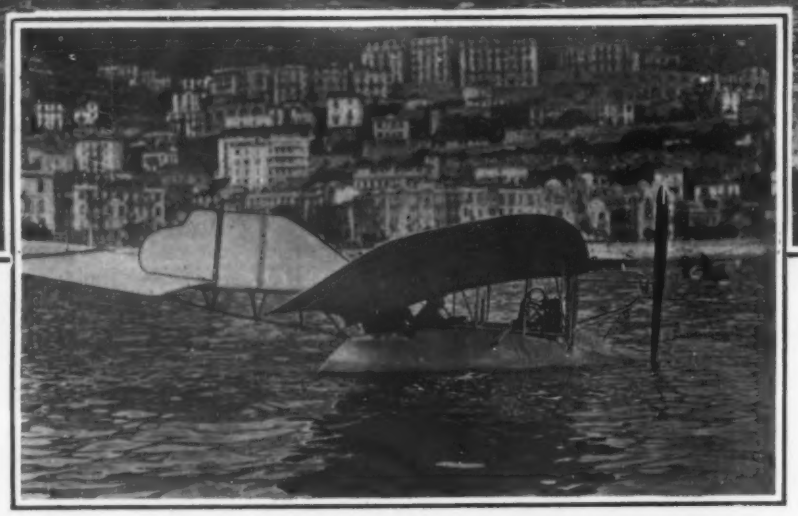
A case of extraordinary, if not unprecedented, horizontal temperature gradient is reported, on apparently trustworthy authority, in the Meteorologische Zeitschrift for March, 1910. With a temperature ranging between 0 deg. and +2 deg. C. at Helsingfors, Finland, on November 18th, 1909, a temperature of 20 deg. to 24 deg. C. was simultaneously recorded at a point only 10 kilometers distant to the north; a difference of about 20 deg. C. (68 deg. F.) in a distance of about 6 miles. While the climate at Helsingfors is tempered by the Gulf of Finland, so remarkable a difference between the temperature there and in the immediate hinterland is inexplicable, especially as the two stations at which observations were made are of the same altitude. The strangest part of the story, however, remains to be told, viz., that a little to the north of the place where the low temperature was reported the weather was almost as warm as in Helsingfors!

THE NICE AVIATION MEET

WITH DETAILS OF THE CROSS-COUNTRY RACE FOR THE LONDON DAILY MAIL'S $50,000 PRIZE

One of the principal aviating meetings which has been held abroad this year was that at Nice, from April 15th to 25th. Two of our illustrations show Farman biplanes that participated in this meeting. The one in flight over the sea was piloted by Duray, an old-time automobile racing driver, while the one which is shown on the beach was piloted by George Chavez. Chavez, on the 17th ultimo, accomplished several long flights above the sea. In one of these the fuel gave out, and the machine landed on the beach, as shown. The meet opened under auspicious weather conditions, and some splendid flights were made on the opening day. At one time in the afternoon four biplanes and a Blériot monoplane were all in the air at the same time. Effimoff, Chavez, and Van den Born, all of whom flew Farman biplanes, made some excellent flights. Rougier also made brilliant flights, on one occasion crossing the Var, and another time flying half a mile out to sea. Metrot flew for half an hour on his Voisin biplane, and Olieslagers made several short flights in his Blériot monoplane, which appeared to interest the spectators more than the biplanes on account of its bird-like appearance. The English entrants in this meet, Messrs. Rawlinson and Rolls, were unfortunate. The first named was unable to fly more than half way around the track the first day on account of trouble with his Darracq motor, which he was using on his Henry Farman biplane, while Mr. Rolls did not receive his Wright biplane from England.





1. Chavez's wrecked Farman machine which dropped into the water when its fuel gave out. 2. Duray flying over the breakers in his Farman biplane. 3. A novel hydro-aeroplane fitted with a three-cylinder Anzani motor.

THE AVIATION MEET AT NICE.

The second day of the meet nearly all the aviators made excellent flights. Herr Grade's monoplane failed to arrive, and so he did not participate in the flights. Effimoff made a flight of 80¾ miles, and Van den Born flew 40 miles. Mr. Rawlinson made a daring flight out to sea. While turning above the water, he was approached too closely by Effimoff, the result being that although the two aeroplanes did not touch each other, Mr. Rawlinson's fell into the sea, and was badly damaged. The Russian aviator was fined for faulty driving.

The results of the first day's flights in the various contests were as follows:

Total Distance Prize.—Effimoff (Farman biplane), 130.716 kilometers (81.17 miles). Chavez (Farman biplane), 105.508 kilometers (65.52 miles). Van den Born (Farman biplane), 87.508 kilometers (54.34 miles). Metrot (Voisin biplane), 15 kilometers (9.31 miles).

This competition was for the total distances flown in all flights made during the day by each competitor.

Starting Prize, Without Passenger.—Effimoff (Farman biplane), 80 meters (262.4 feet).

Starting Prize, With Passenger.—Effimoff, with Prince Koudacheff (175½ pounds), 100 meters (328 feet).

Prize for fastest circuit of the course, $400. Won by Effimoff, who flew 6 kilometers (3.72 miles) in 6 minutes 23 3/5 seconds—a rate of 35 miles an hour.

In this aviation meet over a dozen aviators competed, and many other flights were made.

The greatest sporting event that aviation has had thus far, as well as the chief demonstration of the practicability of the aeroplane for the rapid transportation of individuals, was the race from London to Manchester, England, on the 27th and 28th ultimo, for the prize of $50,000 offered three years ago by the London Daily Mail. On April 23rd Mr. Claude Grahame White, an Englishman, attempted the flight on his Farman biplane. After covering the 115 miles to Litchfield in 3 hours and 6 minutes, he quit battling with the violent wind and the cold. The next day his aeroplane was badly damaged by the wind while in its temporary shelter. It was taken apart and shipped back to London for repairs. Meanwhile aviator Louis Paulhan visited London and entered the race. His Farman biplane arrived from France on April 27th, and after working hard all day at Hendon, he got it assembled and soared aloft at 5:21 P. M., flying immediately to Hampstead (5 miles from London) and crossing the starting line at 5:31. He had a map tied to his waist, and he followed a special train on the railway 1,000 feet below.

Soon after Paulhan started, word was brought to White, who had completed the repairs to his machine and who was resting at his hotel. Rushing in an automobile to his aeroplane, he started at 6:32 from Wormwood Scrubbs in pursuit of Paulhan. But the latter had gained an hour's flying time before darkness settled down, and he alighted at Litchfield at 8:10 just as the 14 gallons of gasoline he carried were entirely consumed. White alighted at Roade, near Northampton, after a flight of 1 hour and 23 minutes in which he covered 60 miles. He started again at 2:54 A. M. and succeeded in getting within about 15 miles of Litchfield before Paulhan again resumed his journey. He flew over Weedon, Crick, and Rugby in the darkness, and alighted at Polesworth, nearly 100 miles from London, after an hour's flight. Late in the afternoon he flew 10 to 12 miles farther, but the race practically ended for him at Polesworth. The conditions required the flight to be made within 24 hours and with not more than two stops *en route*. Paulhan

(*Concluded on page 387.*)

PECULIAR SPIRAL ARCH OF THE ESKIMO SNOW HOUSE.

BY A. L. KROEBER, CURATOR OF ANTHROPOLOGY, UNIVERSITY OF CALIFORNIA.

There is a type of dome that can be built without a scaffolding and that requires a man to be immured within the vault to insure proper construction. It is the invention and sole property of that most ingenious of savage races, the Eskimo, and contains several principles new to civilized architecture.

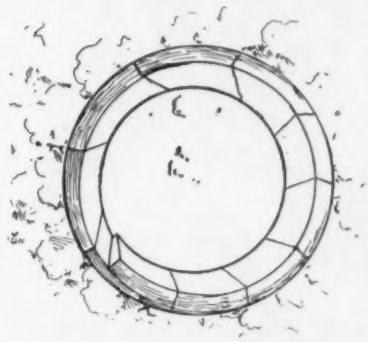
There are four fundamental types of arch and dome, of which one is the Eskimo peculiarity. The simplest and least used, because least effective, is of the simple lean-to type—illustrated by, and to-day chiefly employed for, the house of cards. Next comes the false inverted-step arch, where each block or brick projects beyond the one below, and is held from toppling in by the weight of the material above and behind it. This type of gateway and chamber was invented independently by the architects of Agamemnon more than 3,000 years ago in ancient Greece, and the precursors of the Aztecs in Mexico at nearly as early a period. This construction inherently demands a vast amount of backing, or fill, in proportion to the vault of the arch. It is feasible for a gate in a long wall, or for an underground hall or drain, but cannot stand alone, and is a *false arch*. A free portal, or a dome rising into the air, cannot be built on this principle, which is consequently but little employed to-day. Our true arch embodies the third method, its essential feature being the use of wedge-shaped blocks. When the last and central one of these pieces—the key-stone—is dropped into place the whole mass supports itself. The top cannot fall inward unless the supports are toppled outward. The primary thrust is therefore always not in, but out, and buttressing of some sort is requisite. Another inherent defect of this arch, though we are so accustomed to it that we do not usually note the fact, is that until the key-stone is fitted into final position, a temporary structure must be erected to hold up the parts already in place. The last type, the Eskimo vault, is a true dome, exerts no outward thrust, and requires no temporary scaffolding. It is also unique in that its material is not brick or stone, but *snow*.

The construction is used for the beehive-shaped winter houses of these so-called savages, and is spiral in plan, as shown by the diagrams. A row of blocks is first laid on the ground in a circle—or more exactly a polygon. Each of these has a slightly slant top, and each thus raises its surface a little beyond the last, until when the circle is completed, the gap in height between the last and first blocks gives the thickness for the following courses. In these the upper and lower surfaces of each block are parallel, as in a brick, but the gradual upward trend given by the first course is of necessity maintained.

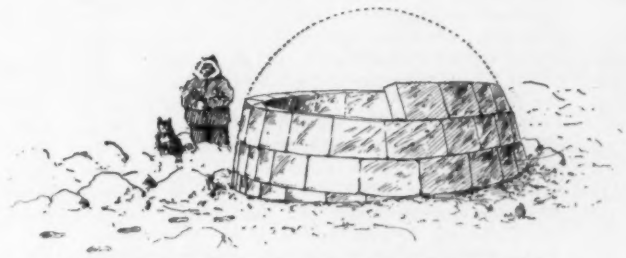
In each successive round the snow-bricks are leaned inward more, by having their lower surfaces sliced off to a bevel. If set squarely end to end, they would before long lean inward so far that they would tumble. For this reason the end of the block last laid is cut at an angle. The next following block has the joining end slanted at the reverse angle. Thus it fits in behind the preceding, and is prevented by it from slipping inward. As the house grows, the circles become smaller, until at last only an irregular polygonal opening is left. This is filled with a wedge-shaped block cut to shape. It is however not a key-stone, as the remainder of the structure supports itself.

The blocks of firm snow are usually dressed outside, and handed for placing to the man on the inside. The last block he holds up with one hand, slices to shape with his ivory knife in the other, and drops into position. He is then entirely inclosed in the vault. Only after the house itself is entirely completed does he cut out the low door, which, to keep out the cold as much as possible, is only big enough to crawl through. A long, low tunnel is then built in front of the door, to break the force of the Arctic's icy blasts. Even a window is present. A small aperture is cut out over the door and filled with a pane of clear thin ice. All that is omitted is the flue or chimney. Whatever heat is produced by the seal-oil lamps is wanted inside, warmth being a more serious necessity in the climate than ventilation or freedom from smoke.

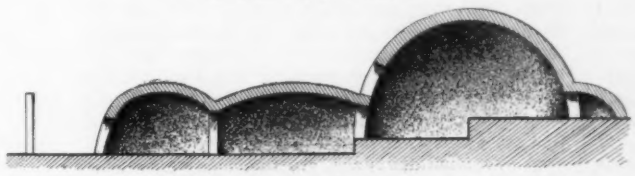
Whether the type is practicable in other materials has been doubted. The unsurpassed lightness of snow is certainly a great advantage. In heavier materials strength would, however, compensate for increased stress of gravity, and good mortar should make up for the inward slipping tendency that weightier materials would show.



Plan view of partly built hut, showing how each block supports the next.



Eskimo hut partly built. The snow blocks are laid in a continuous spiral course.



Section through Eskimo snow house.

THE PECULIAR SPIRAL ARCH OF THE ESKIMO SNOW HOUSE.

The greatest difficulty in working in stone would be encountered in shaping the separate pieces of masonry. Owing to the spiral and leaning construction, no two blocks can be exactly alike in either shape or size, and in every succeeding course each block departs more and more from the right-angle in its proportions. To compute in advance exactly the proper angles for each piece, so as to insure true joints, would be a matter of much complex mathematical calculation.

It might however be practicable, once the calculations had been determined for a building of standard size, to draw up a table of the angles and dimensions required for each successive block. If the size of the structure were reduced or increased from the standard, each stone would only require to be diminished or enlarged by a fixed ratio.

It would take our ablest engineers longer to plan such a dome than an Eskimo would need to build a village; but the resulting simplicity of construction, due to the inevitableness and simplicity of the progress of erection, without any temporary supports, buttresses, or reinforcement, might more than compensate.

The spirally ascending bevel-locking Eskimo dome is the only true vault any part or the whole of which will stand entirely by itself.

A GASOLINE MOTOR-DRIVEN EARTH-BORING MACHINE.

BY WALTER LANGFORD.

The details of construction and method of operation of a unique gasoline motor-driven earth-boring machine are shown in the accompanying illustration. The device was recently designed in California by Charles L. Beltz, and the photograph represents it in working position in actual operation at Sacramento and near Selma, Cal.

It is stated that with one of these machines about 25 miles of holes were bored for use in fencing along the right-of-way of the Western Pacific Railroad between Marysville and Oroville, Cal. These holes were bored under particularly trying conditions as the ground was gumbo land with the exception of a short stretch of marsh soil, and so hard and so dry that every bit of it had to be broken with pick and crowbar when dug by hand. Part of it, in addition to the hard ground, had about 20 to 25 per cent small cobble, yet this labor-saving device bored through all of it and did the work of from twelve to fifteen men.

Such a machine is of great value for boring holes for posts, for numerous other uses for which shallow holes are required and for the purpose of lightening the labors of man. Experience shows that the harder the ground and the more difficult it is to work, the more earnestly a machine of this class is desired.

This entirely new, unique and practical engine-driven apparatus is a most remarkable device in its simplicity, and owing to its wide range of uses as a labor saver it stands unsurpassed. It will be seen that it is extremely simple, easily operated and entirely practical, and will be found a great economizer of time and money where post holes are to be dug, electric line, telegraph or telephone poles set, or where trees and vines are to be planted in holes uniform in size at top and bottom and of suitable diameter and depth.

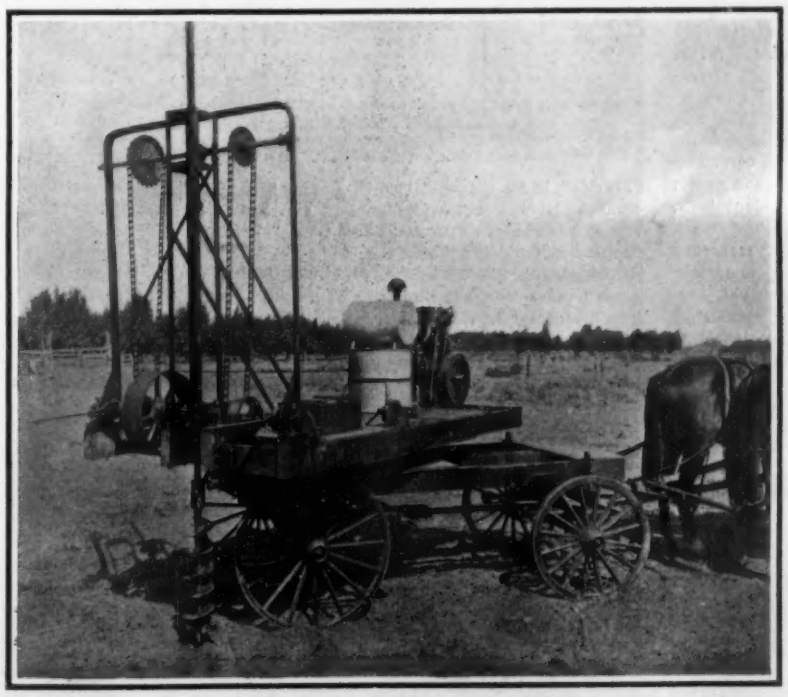
It is held to be practical for use everywhere, as by test the machine will work satisfactorily in either dry or wet soil or in any place where the machine can be driven, as it bores readily through hardpan and shale, soft sandstone and small cobble; and as it will bore at different angles and on either side or back of the truck, it will do equally good work whether on level ground, uneven ground or hillside.

Near Reedley, Cal., a great number of holes were bored in very hard hardpan for large poles, the machine being particularly successful in this work because the contrast between its efficiency and hand labor was so strongly marked. At Mendota, Cal., a record was made by one of these machines on large fence work in hard, dry earth, 90 holes being bored 33 feet apart and 30 inches deep in 60 consecutive minutes, the holes being 8 inches in diameter.

For use in boring small holes, a vertical engine of the double cylinder type is utilized that develops 7½ horse-power. In boring holes for large poles a machine of this type is fitted with an 18-inch auger, effecting a depth of 6½ feet. The power is supplied in this case by a double cylinder gasoline engine of 12-horse-power capacity.

This device is said to be inexpensive to operate, as a man and a boy only are required for its efficient working, the boy to drive the team, and the man to manage the machine. Its net earning capacity is said to be greater than that of a threshing machine costing five times as much. Its season of usefulness extends over the entire year, and in many instances in hard ground has done the work of fifteen men.

It is maintained that in cold countries where other farm work



WORKING POSITION OF EARTH-BORING MACHINE READY TO BORE A HOLE.

is impractical during the severe season, post holes can be dug and fences built during the winter, as this machine is well adapted to boring through ice, frozen ground, hardpan, shale, and the like.

In the planting of orange trees, peach trees, grape vines or in having a piece of land underlaid with hardpan in which holes for any purpose are expensive to dig, this form of machine will do the work of making an opening through any crust for the top root of the tree.

The upper frame and boring tower being on a rotatable platform, one can easily adjust the machine to a hole on either side or at the rear of the machine. When the device is in a position to bore a hole, all that it is necessary to do is to pull the feed clutch, and the auger drops to the ground and begins work; when the auger is loaded, by releasing the feed clutch and pulling the hoist clutch in, the auger is hoisted clear of the ground, or to any other position that may be desired.

It is of interest to note that besides boring in the kinds of soil before mentioned the machine will bore in dry clay, or in swamp land without any change of augers or bits, no ground being too sticky for it to work. There is no necessity of stopping the machine to clean mud off the auger, as the machine does that itself.

If there is an occasion to bore a line of holes down the middle of a well-traveled road it will do the work without difficulty. A small type of earth-boring machine has been designed which will bore to a depth of 4 feet and which is equipped with two augers, 8 and 12 inches in diameter, while a larger machine has been developed which will hole to a depth of 6 feet. The latter is fitted with three augers, 8, 12, and 16 inches in diameter.

It is stated that no change of shaft or auger is required to make the depth indicated. The time required to move from one hole to another and begin work in a fence line is from 15 to 25 seconds.

The feed pinion of the machine as well as the feed rack, drill shaft, gearing, and auger shaft are made of crucible and machinery steel so as to withstand a sudden impact, as when stopped by running against rocks, old posts and similar obstacles.

Chain belting is used of the standard sprocket type, and in case of a break can be easily replaced. It will be seen that this machine in boring does not scrape the earth, but cuts it with chisel bits, which are quickly detachable, the entire set being changed in two minutes if desired.

It is reported that this machine has bored many holes 30 inches deep in hard ground in fifteen seconds for each hole from the time the auger touches the ground, and it is hard ground indeed when the hole cannot be bored in a minute. It has force feed, and therefore all the attendant has to do is to pull the lever and the machine does the work.

LAUNCH OF THE "FLORIDA."

On the morning of Thursday, May 12th, there will be launched at the Brooklyn Navy Yard the second of the two largest battleships yet built in the United States, the "Florida." The sister ship, the "Utah," which, in December last took the water at Camden, N. J., from the building slips of the New York Shipbuilding Company, weighed about eight thousand tons. The launching weight of the "Florida" will be about nine thousand tons, which is, in itself, a record for an event of this character. The keel of the "Florida" was laid on March 9th of last year, and the work of construction has been carried on uninterruptedly under the supervision of Naval Constructor William J. Baxter, with Naval Constructor William G. Groesbeck immediately in charge.

In view of the great importance of the ship, and the gratifying rapidity with which she has been built, preparations have been made to render the ceremony of launching particularly brilliant. Among the guests on the launching platforms will be President Taft, Secretary George Von. L. Meyer, Assistant Secretary Beekman Winthrop, Albert W. Gilchrist, Governor of Florida, with his staff; Admiral Dewey, and Rear Admirals Evans, Sperry, Schroeder, Wainwright, Potter and Luetze. As the battleship fleet is now present at the yard, between six and seven thousand bluejackets and the officers of the ships will assist in giving dignity to the event. In agreement with the custom of having our ships christened by a representative of the State or city after which they are named, the ceremony will be performed by Miss Elizabeth Fleming of Jacksonville, Fla.

The naval constructors and employes of the Brooklyn Navy Yard are to be congratulated on having, for the second time, demonstrated that they are capable of building the largest and most modern warships, not only with dispatch, but of the most thorough and durable workmanship; for it will be called to mind that from these very ways there was launched on September 29th, 1904, the flagship "Connecticut," which, although a much smaller ship than the "Florida" (less by about 6,000 tons, in fact) was nevertheless the largest vessel of her time in the United States navy, and approximately as large as any vessel in the navies of the world. It is a long step, however, from a 16,000-ton "Connecticut" to a 21,825-ton "Florida," and the Brooklyn Navy Yard should receive full credit for the fact, that while eighteen and a half months elapsed from the laying of the keel to the launching of the "Connecticut," it has taken only fourteen months to do the same amount of work on the big ship. The material has been built into the hull at an average rate of about twenty-five tons per working day of eight hours. If all goes well, the hull and accessories will be completed early next spring. The date of the completion of the machinery is somewhat uncertain, the recent reorganization of the navy yard having thrown the steam engineering shops somewhat out of their stride.

The greater length of the "Florida," which exceeds the "Connecticut" by over sixty-five feet, her greater beam of eleven feet four and a half inches, and her increased launching weight of many thousand tons necessitated, of course, a great enlargement and strengthening of the permanent and launching ways, and severely taxed the capacity of the building slip. Our front page illustration shows how the ram of the ship extends entirely across one of the streets of the yard and abuts against the wall of a building.

In spite of this fact, the stern of the vessel reaches almost to the bulkhead wall on the water front.

Just here it is well to notice how, in order to secure the desired speed of 20.75 knots, the lines of the ship have been fined out, as compared with former battleships. The entrance of the "Florida" appears to be as fine as that of our armored cruisers. At the same time, in order to secure good lifting power forward, when the ship is driving into head seas, above the water line the sections are flared out very rapidly, thus giving the ship a form which is not only buoyant and seaworthy, but adds greatly to the appearance of the vessel.

The "ways" consist of the permanent ways made up of the supporting piling, cross caps and longitudinal timbers, and the launching ways, in which she immediately rests, built to conform to the underwater form of the ship, which travel with her as she moves down into the water. The heavy longitudinal timbers, which form the sliding surfaces between the fixed and launching ways, are thoroughly lubricated with a special preparation, consisting chiefly of tallow, lard oil and graphite. The contact surfaces are made sufficiently broad to bring down the maximum pressure on the ways to 2.3 tons on each square foot. The ship is released and started on her swift slide into the water by sawing through the "sole beams," which are the last members that connect the launching ways with the permanent ways. The "Florida" will move very slowly at first, but gather way rapidly, and her highest velocity will be about twenty miles an hour.

With the launching of the "Florida," the United States navy will have afloat its first complete division of ships of the dreadnought type, consisting of the "Delaware," "North Dakota," "Utah," and "Florida." A study of the accompanying table shows that the "Florida" is an enlarged "North Dakota," having the same length between perpendiculars, and two or three feet greater length over all; three inches more beam; one foot seven inches more draft, and 1,825 tons greater displacement. She is designed to have three thousand more horse-power, but a quarter of a knot less speed. The armament in each case consists of ten 45-caliber 12-inch guns mounted in five turrets on the center line of the ship. The 12-inch pieces for the later ships in the case of the "Wyoming" class will be more powerful, being fifty calibers in length, with a correspondingly greater muzzle velocity and energy. In the broadside, torpedo-repelling battery, the "Florida" has two more 5-inch guns than the "North Dakota."

COMPARISON OF THE "NORTH DAKOTA," 1908, AND THE "FLORIDA," 1910.

	"North Dakota."	"Florida."
Length	518 feet 9 inches.	521 feet 6 inches.
Beam	85 feet 2½ inches.	88 feet 2½ inches.
Draft, mean	26 feet 11 inches.*	28 feet 6 inches.†
Displacement	20,000 tons.	21,825 tons.
Coal supply	2,500 tons.	2,500 tons.
Oil	400 tons.	400 tons.
Belt armor	12 inches to 8 inches.	12 inches to 8 inches.
Turre tarmor	12 inches.	12 inches.
Battery armor	6 inches.	6½ inches.
Smokestack protection	6 inches.	9½ inches.
Twelve-inch guns	Ten.	Ten.
Five inch guns	Fourteen.	Sixteen.
Speed contract	21 knots.	20.75 knots.

* With two-thirds full supply ammunition and stores.
† With two-thirds full supply stores and fuel and full supply ammunition.

It is claimed by our Navy Department that the "Florida" and her sister are the best-protected warships afloat, special attention having been given in her design to guarding the vital parts of the ship against mortal injury, and to the localizing of the destructive effects of projectiles and torpedoes. Against sinking by torpedo attack the "Florida" is safeguarded by an elaborate sub-division of the hull and an unusually powerful pumping plant for ridding the ship of such water as may enter. Against gun fire she presents probably a more complete system of armor protection than any contemporaneous warship. The main armor belt, over eight feet wide, has an average thickness of eleven inches; above this is another eight-foot belt averaging nine inches thick, while the five-inch broadside battery on the main deck and the bases of the smokestack carry heavier armor than has been placed on any previous United States ship, the front wall of armor being 6½ inches, while back of the guns runs a wall of 3-inch armor. To reach the bases of the smokestacks a shell would have to pass through 9½ inches—an unprecedented but, as the Japanese war showed, a necessary protection. Between each pair of 5-inch guns is a 2-inch transverse, splinter bulkhead.

The "Florida" will be driven by an equipment of Parsons turbines, working on four shafts. They are required by contract to develop 28,000 horse-power, which, it is estimated, will enable the ship to maintain an average speed of 20.75 knots on trial. As a matter of fact, she is likely to do from three-quarters to a knot better than this. The "Florida" will store, in addition to 2,500 tons of coal, some 400 tons of oil fuel. Our naval constructors have long recognized the value of oil as an auxiliary fuel, and as far back as 1907, when the plans of the "North Dakota" and "Delaware" were drawn, provision was made for storage of oil, the ships of that class carrying 400 tons.

The keel of the "Utah," built by contract with a private yard, was laid on March 15th, and the keel of the "Florida" on March 7th. The "Utah" was launched on December 23rd, 1909, at the 50 per cent stage of completion, and the "Florida" on May 12th will take the water with 68 per cent of the work completed, a comparison which establishes once more the much-contested claim of the Brooklyn Navy Yard that it can build as rapidly as the private yards.

The Lubricating Value of Mineral Lubricants at High Temperatures.

The behavior of a mineral lubricant at very high temperatures is dependent upon its chemical and physical properties, upon the nature of the atmosphere with which it is in contact—dry air, carbon dioxide, or water vapor—and upon the pressure of this atmosphere. Schreiber in a recent article describes his investigations of the lubricating value of mineral lubricants of very high melting points, in various conditions. The diminution of the lubricating power at high temperatures is due to the evaporation of a portion of the lubricant and to the formation, by oxidation, of compounds of the nature of asphalt, i. e., compounds insoluble in benzine. It is not due to polymerization, as is generally believed. This increase in asphaltic matters is not produced in the presence of water vapor alone, even at a pressure as high as 7½ atmospheres. In this case the diminution of the lubricating power is due solely to the evaporation of part of the lubricant. On the other hand, when the lubricant is in contact with a gas which can exert an oxidizing action, compressed air, for example, the formation of these insoluble compounds is the chief cause of deterioration. Schreiber deduces from these experiments laboratory methods of measuring the lubricating power at high temperatures, according to the class of machine in which the lubricant is to be used.

The Current Supplement.

The current Supplement, No. 1792, contains an unusual number of interesting illustrated articles. Mr. Harold Holcroft contributes a splendid paper full of practical suggestions and helpful ideas on the principles of vitreous enameling of cast iron for industrial purposes. Mr. Henry A. Wise Wood's excellent review of modern stereotypy methods is continued. Rear Admiral R. H. S. Bacon critically considers the armorclad, and points out what type of vessel is likely to be evolved from it in the future. The North African region lying in Algeria and Tunis affords almost an unlimited field for achæological research. Some recent discoveries in this country are described in an illustrated article by the Paris Correspondent of the Scientific American. It is very difficult to recognize stars by studying the star maps and then seeking the stars marked on the maps. Mr. F. R. Russell, in an article entitled "Where to Find the Stars," provides the necessary link between the star maps and the sky. A table of aeroplanes at Olympia is published, with some observations on the theories of flight. The food supply of the future is considered by H. B. Armsby.

La Lumiére Electrique publishes a series of articles reviewing the effects of the great Paris flood in January, 1910, upon the electric stations, telegraph, telephone, and electric light service of Paris and its suburbs. The St. Denis establishment escaped inundation owing to its judicious arrangement of pumps and sluices and its elevation above the ground, and continued in operation without any interruption. Most of the other plants were less fortunate. Even the new underground wireless telegraph station at the Champ de Mars was submerged for several days, and its delicate apparatus was very seriously injured.

Correspondence.

WHY WATCH SPRINGS BREAK.

To the Editor of the SCIENTIFIC AMERICAN:

It was with an amateur's interest that I read the discussion in your pages as to "Why watch springs break." As the question apparently still remains unsettled, I feel tempted to contribute some additional views on the subject.

Formerly clock springs were finished very rough, giving the convolutions considerable frictional grip upon each other. For this reason, when running down, there was a very audible shuffling sound within the clock every few minutes, indicating the propelling force was spasmodic. Not only so, but the ticking sound of the escapement decreased in loudness as the time was prolonged from the last loosening of the coil. To regulate this it occurred to me to apply a more unctuous lubricant to the spring to prevent the said friction. The result of so doing was a gratifying uniformity of tick—but only for a few hours—until the spring broke.

After the third experience of this kind I ceased to regard it as a mere coincidence, and thereafter applied no oil if there was sufficient to prevent rusting already on the steel.

The uncoiling of a watch spring and of the kind of clock spring that has just been described differs in that the watch spring unwinds from the outside of the coil, while the clock spring arbor backs up and unwinds from the center of the coil. For this reason the latter is not subjected to a breaking from contraction due to cold, as there is always some room for the contraction to take place—excepting a possible momentary period just after winding. The same is not the case with a watch spring.

If over-lubrication is destructive to the structure of steel in a clock spring, by rendering all the convolutions continually active and under unremitting strain, the same would also apply to a watch spring. Watch springs being smaller than those intended for clocks are naturally proportionally stronger and may endure the strain longer, but that it is detrimental is probable. But oil on a watch spring is absolutely necessary solely to provide for this thermostatic movement which can only take place back and forth, to and from a fixed point—the arbor. Yet the wearying strain on a spring due to over-lubrication can only be a contributory cause to the prevalent breaking of this part. Experience goes to show that the most frequent time for breakage is from an hour to three hours after winding, and that the most frequent position of fracture is just outside of the annealed tip attached to the arbor.

Thus the owner takes his watch from his pocket, where its temperature was, say 80 deg., and winds it until it brings up hard. The coil is then central and solid upon its arbor, which is held fast by a pawl and ratchet.

In a little while the wearer of the vest containing the watch removes it, hanging it on the back of a chair while he retires for the night. The temperature of the watch gradually falls to say 60 deg. Has contraction been provided for? The morning will disclose. If the coil has not been wound too tightly on, if some time has elapsed before cooling to enable it to draw on what has been paid out, or even if the rate of cooling and consequent contraction has not exceeded the rate of release due to the movement of the works, the spring may escape. But what surprised the writer is not the breakages but the length of service many springs attain.

When one considers that the greatest movement of contraction is on the outside of the coil, because of its greater area, that the coil has just been rendered taut and rigid by winding, and that then a powerful contracting force is added thereto, principally on the outside of the circle where the leverage is greatest, it is not difficult to realize what an unendurable strain takes place close to the fulcrum, the arbor, for the spring is then but a solid lever.

The fracture of a spring in many places is also not hard to understand, if we imagine a spring stretched to its elastic limit by contraction from cold with no slack to draw upon, each turn of the spring, from the outside inward, at an ever-increasing tension. An inner turn snaps, instantly contracts, and by that process increases the spreading or expanding trend of its temper. The change is altogether too rapid to permit of any uncoiling movement, and the force thus added to the adjacent surrounding strand fractures that, gathering force with each succeeding fracture until, like a "Prince Rupert's drop," the pent-up strain comes to rest with explosive suddenness.

That the pieces display magnetism does not necessarily indicate that it was produced from external influence, but rather that it was evolved by excessive strain and retained by the steel by virtue of its hardness, as is similarly evidenced by many machinists' tools subjected to severe service.

Regarding the preference of springs to break in the summer months, is it not sufficiently evident from the following three causes?

1. The more constant and wearying strain due to the better lubricating effect of warm oil.

2. The increased solidity of the coil when wound up, due to a thinner film of oil between the convolutions, also due to warmth.

3. The looser texture and greater proportional shrinkage of a warm spring compared with a cool one.

As to the remedy for this uncertainty of time-keepers, it would seem sufficient to provide for the longitudinal expansion and contraction of the springs, and the simplest way would be to make them of metal insensitive to these changes. Such an alloy has been described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1714, by M. Guillaume, which he calls "Invar" and is composed of steel with an admixture of 36 per cent nickel. It is used for spiral springs, pendulums and graduated scales for instruments. The fact that it does not rust should complete its adaptability to this purpose, as then it could be used without lubricant and thus, except for a short portion at one time, be relieved of continuous and active strain.

Just how the nickel component will affect its permanency of temper remains to be proven, but even if it retains sufficient recoiling force for its purpose for five years only, it would at least give warning of its waning strength and not leave its owner in the lurch, which is perhaps all the improvement needed.

Another possible remedy which modern practice would indicate as quite feasible would be to carbonize the rods or plates, from which the springs are drawn, from one side only. The result would be, when chilled, a hard side (for the inner side) and a soft or elastically tough side (for the outer side) with a general benefit of greater spring power with improved tensile strength.

Watchmakers will tell you that the breaking of main springs saves many good watches from having their pivots cut off, from shear wear, and the views of the manufacturer need not be consulted, but the ordinary citizen would prefer to have the spring as reliable as the rest of the watch.

JAMES E. FRASER.

St. John, N. B.

INTERESTING MAGIC SQUARE.

To the Editor of the SCIENTIFIC AMERICAN:

In the December 11th issue of the SCIENTIFIC AMERICAN (page 436) Mr. A. Galpin gives an interesting construction of magic squares, containing all the odd

42	34	26	18	1	74	66	58	50
52	44	36	19	11	3	76	68	60
62	54	37	29	21	13	5	78	70
72	55	47	39	31	23	15	7	80
73	65	57	49	41	33	25	17	9
2	75	67	59	51	43	35	27	10
12	4	77	69	61	53	45	28	20
22	14	6	79	71	63	46	38	30
32	24	16	8	81	64	56	48	40

numbers in the inscribed diagonal square. But this construction is applicable not only, as Mr. Galpin says, when the basis is a prime number, but more generally when the basis is an odd number (1, 3, 5, 7, 9, 11, . . .). The proof is very easy: there is here the square of 9, as example of the simplest odd number not prime: the general proof is an interesting exercise of algebra.

DR. G. VACCA.

Genoa, Italy.

HYDROGEN IN A HOT-WATER SYSTEM.

To the Editor of the SCIENTIFIC AMERICAN:

A short time ago I noticed a phenomenon which I believe will be of interest to many of the readers of the SCIENTIFIC AMERICAN.

The main building of our experiment station here is heated with hot water. It has been one of my duties to see that the system is working properly, and in this connection I have had to open the air vents on the radiators frequently. I was surprised to find that the radiators on the top floor (a two-story building) always seemed to have air in them, in spite of the fact that the system was fully charged and very little or no new water admitted. I began to suspect that this condition had to be accounted for in some other way. Was there not a possibility that this gas could be hydrogen? For what other gas would be likely to form under those conditions, unless it be a trace of carbon monoxide? At any rate, when I applied a match the gas lighted with the familiar pop of hydrogen, and burned with its characteristic almost colorless flame. Assuming that the gas is hydrogen (I have no means of testing it) the question suggests itself: Is this a case of oxidation of the iron setting free hydrogen? Is it an electrolytic effect, caused by galvanic couples of either carbon and iron or iron and the brass connections in the system? Or is the gas methane? It may be noted further that the gas does not seem to collect in the radiators in the lower floor to a great extent, if any. Of course, this may be due to the gas being dissolved under the increased static pressure. The static pressure on the radiators of the top floor is not over ten feet of water at the present time. The water is of exceptional purity, being supplied by a spring. The fact, however, that small quantities of water have to be added occasionally to replace the leaks in the system might suggest the presence of methane. That question can only be settled by chemical analysis.

Puyallup, Wash. C. WESTERGAARD.

AN EARLY APPEARANCE OF ENCKE'S COMET.

To the Editor of the SCIENTIFIC AMERICAN:

The change which has come to the people in reference to comets is worthy of notice. Seventy years ago, when Encke's comet made its appearance, a great deal of fear was aroused. I was a young boy, but remember very well the alarm of the people. It was indeed very strange and portentous, for it switched about from the zenith to the horizon, and was very brilliant. Its color varied from a light to a fiery red, and its length was such that it stretched from the zenith to the horizon. It hovered so long and was so conspicuous that all classes, young and old, were greatly impressed. About that time the Millerite excitement prevailed, and there were many who looked upon the comet as a sure sign that the world was surely coming to an end. There have been other comets which impressed the people, but this exceeded all others in the impression made.

Salem, Mass. STEPHEN D. PEET.

A New Sense Organ of Butterflies.

Every butterfly collector has had the unpleasant experience that some butterflies, and particularly those of the species of Catocala (mourning cloak) will notice his approach from a distance and fly away in time. This observation led Tetens to think that these animals must have an auditory organ which warns them of approaching danger by receiving sounds; and accordingly he expressed the supposition that two pit-like depressions at the first posterior segment of the body might be organs of hearing. A thorough investigation of this organ, however, has been made but recently by Prof. Dr. Deegener, the results being published in Zoologische Jahrbücher, Abteilung für Anatomie, vol. 27, No. 4, 1909.

It is rather surprising that with a group so frequently collected (although indeed investigated, as a rule, only as to their position within a system) as the Noctuidæ, an organ could escape observation which is found quite generally in this group and which is by no means microscopic, but can be observed without difficulty with the naked eye as a striking formation on each side of the first abdominal segment. This location probably explains why this organ should have been seen by many persons without arousing the suspicion that it could be a sense organ; for naturally enough such organs are looked for chiefly at the head, particularly at the feelers, although other parts of the body may be the seat of specific sense organs; for instance, grasshoppers have their organs of hearing at the base of the abdomen, that is, at the same place where the corresponding organ of the Noctuidæ has been discovered.

When examining the animal we see on each side at the line separating the chest from the abdomen and near the points where the rear wings are attached, a deep channel which toward the surface is surrounded by several humps. The external morphology of this organ varies in details with the different species of Noctuidæ; with some, the opening is scarcely visible from the outside, being concealed by long hairs set close together. The microscopic examination of a series of sections shows that only one of the ridges in the vicinity of the cavity of the organ, the one nearest the back, can be considered a "sensitory ridge," but that this one has true sensitory cells and sensitory hairs and thus gives the organ the character of a sense organ. Tetens's supposition, mentioned above, that this is an auditory organ, may very well be maintained, since the structure of the organ answers all the requirements of an organ of hearing. Still, experimental confirmation of this hypothesis will have to be awaited. Dr. Deegener promises a further report, dealing with this phase of the subject.—Prometheus.

Approximately 3,748 miles of new main track were built in the United States during the year 1909, as compared with 3,214 miles for 1908. The 1908 record was the smallest since 1897, when 2,109 miles were built. These figures do not include new second, third, or fourth track sidings or electric lines. The net increase during the year is about 16½ per cent, and 28 per cent less mileage was built than in 1907.

REINFORCED CONCRETE WATER WORKS CONSTRUCTION

BY FRANK C. PERKINS

The accompanying views of the Indianapolis water works show an interesting application of reinforced concrete to this class of construction. A gravity flow supplies the reinforced concrete filter plant from the Indiana State Central Canal, which was constructed originally by the State for transportation purposes, but was taken over for water works service. At a distance of about 6 miles above the intake to the filters are located the head gates and concrete sluice ways of this canal, which is carried over Falls Creek, near the filter plant, in an open aqueduct at an elevation of about 18 feet above the creek.

The chemical house columns, floors and walls, as well as stairways and roof, are of reinforced concrete throughout. The lower part of the building contains the lime saturating tanks, over which are constructed the iron solution tanks, all of which are of concrete. They are used in connection with the coagulating basins in the treatment of the raw water during seasons of excessive turbidity.

The following account of these works is based upon data furnished by the constructing engineer, William Curtis Mabee. The water, which is drawn from the Raw River, is clarified by coagulation in precipitation basins, which are provided with baffle walls spaced 70 feet apart, and which are reinforced for the prevention of cracks. A 4-inch slab of concrete, reinforced with twisted rods spaced 4 feet apart in each direction, is used for lining the sloping embankments of earth, while the slab floor, laid in blocks 8 feet square, is 4 inches in thickness.

The water is measured in a Venturi meter, 42 inches in diameter, which has a throat diameter of 21 inches. The meter is built in the raw water conduit, the indicating apparatus being located in the laboratory.

A reinforced concrete pipe line which is 840 feet in length, and has a diameter of 66 inches, and a shell 6 inches thick, conducts the raw water to the precipitation basin. The pipe is laid 11 feet below the hydraulic gradient. It is reinforced with ½-inch twisted bars spaced 8 inches on centers, the shell of the pipe being built in three operations.

In the construction of the conduit a concrete cradle 30 inches wide was first laid to grade. In this were imbedded the lower rods, which were heated and bent in the field to the required shape, and left long enough to project a foot into the upper ring. On the cradle were then placed the semi-circular metal forms, which were fastened down by staked timbers. The mixture of cement, in the proportion of 4 of gravel, 2 of sand, and 1 of cement, was poured into the space forming the lower half of the pipe. The upper half was then constructed by inverting the metal forms. The cost of the pipe, which contained about 300 cubic yards of concrete, was $12.46 per cubic yard.

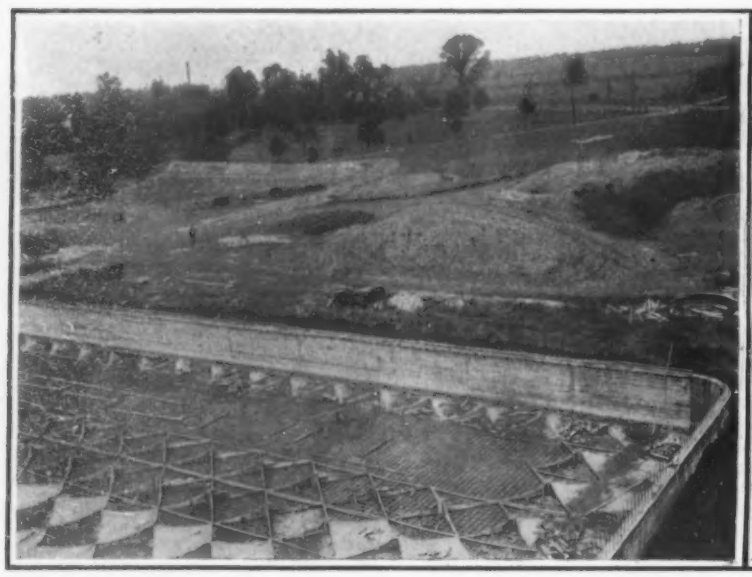
The pure water reservoir, with a capacity of 5½ million gallons, was built near Falls Creek, on a gravel foundation, at ordinary ground water level. The earth filling is 2 feet deep on the cover, the weight of the structure itself overbalancing any upward pressure that may occur. The groined arch bottom was designed to resist the upward thrust of high ground water, at such times as the reservoir is empty, the inverted groined arch construction distributing the load uniformly over the bottom. The reinforcement of the bottom consists of ½-inch twisted bars, spaced 10 inches on centers in each direction.

The filter cover consists of reinforced 3-inch slabs, supported by concrete beams, a trifle less than 20 feet long, and spaced nearly 7 feet on centers. The beams are 8 inches in width and 15 inches deep. They are carried on 18-inch I-beams, incased in concrete and bolted to the columns. The reinforced partition walls, 1 foot thick, are 350 feet in length. They are reinforced in both directions, and measure 14 to 17 feet in height. The entire slab covers 70,000 square feet in each double filter. It is built monolithic, without any attempt to provide expansion joints. A cable tramway with a span of 450 feet was used in the construction. A stationary engine and cable was used for propelling a shuttle car on a narrow-gage track, over which the concrete was handled from the mixer to the cableway, 80 cubic yards per day being used in covering 5,000 square feet of surface. The cost of the filter covers was $14.65 per cubic yard, and the cost of the walls $12.06.

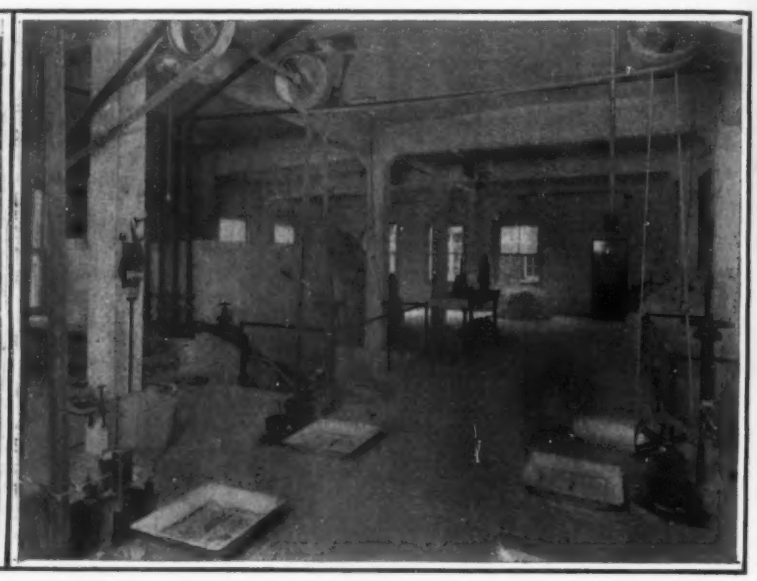
The reinforced concrete aqueduct, 300 feet in length, contains 4,500 cubic yards of concrete, which cost $6.52 per cubic yard including the cement, steel, sand and gravel, as well as the lumber, forms, labor, and concrete labor. It is 41 feet wide and has four spans of 60 feet each with a 10-foot rise from the springing line to the soffit, and a crown thickness of 18 inches for each of the four segmental arches.

The foundations for the piers, wing walls and abutments were carried down 16 feet below low water, and rest upon a bed of sand and gravel. The aqueduct takes the place of a wood aqueduct, which was supported by steel trusses on masonry piers, all of which were carried away by a flood which undermined the middle pier; the superstructure breaking up as the substructure crumbled away.

With regard to the use of concrete for works of this character, Mr. Mabee, the constructing engineer of these water works, makes the following comments:

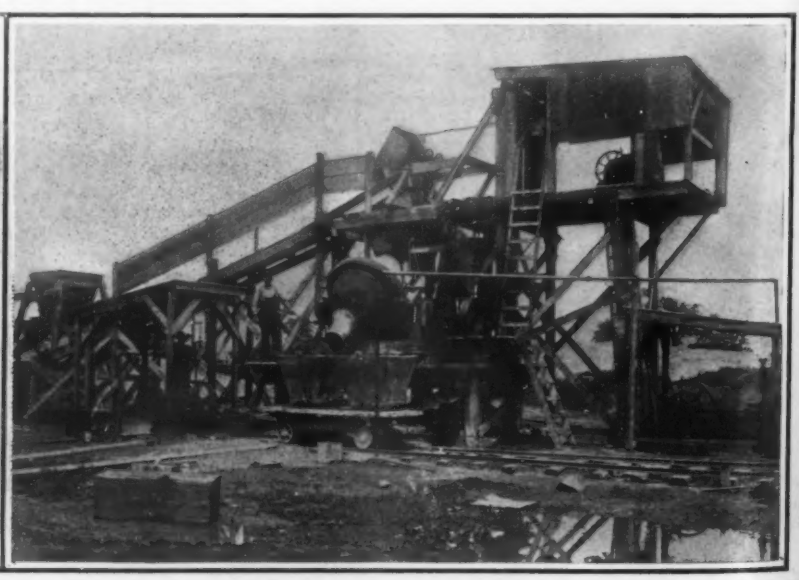


View showing construction of the groined-arch floor, with the reinforcement and forms in place.



Operating floor of the chemical house in which the water is purified in lime and iron saturating tanks.

Steel reinforcement of the 66-inch conduit.



The central concrete plant for mixing the concrete.

REINFORCED CONCRETE WATER WORKS CONSTRUCTION.

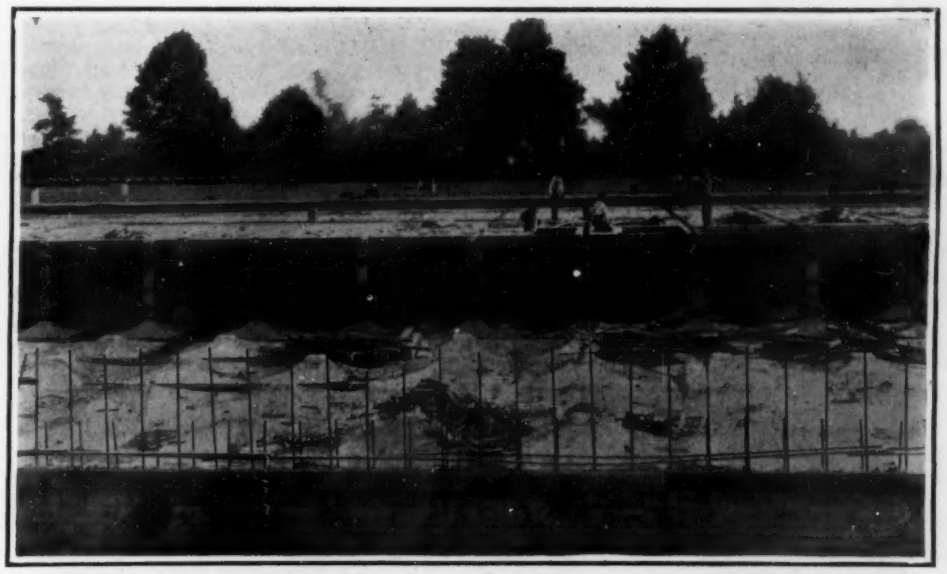
Concrete has many advantages over other types of construction. It is easily and conveniently handled and transported, often at a less cost than stone masonry, and often suitable sand and gravel for the work in hand can be found on the site. With proper supervision, skilled labor is not essential in the usual work; moreover, the art of mixing and handling concrete has been so perfected that machines do most of the work. Concrete has the additional advantage over stone that it may be molded into intricate shapes.

To produce concrete surfaces of a satisfactory smoothness and uniformity, it is necessary that the molds be carefully and properly built, and also that the concrete be of the proper consistency to flow readily into the prepared molds. It is also necessary to thoroughly churn and keep it in motion in the molds until the air has been removed and every crevice filled with mortar. Properly handled in this manner, it will not be necessary to brush or plaster the work after the removal of the forms. Concrete may be placed in moderately freezing weather, provided proper precautions are taken to warm the gravel or stone and sand, to heat the water and to cover the work until initial set takes place.

The problem of preventing ugly cracks forming in concrete is one that has worried many engineers. Plain concrete is liable to crack where you least expect it; and it has become the practice to provide for these cracks by building short sections in alternate blocks. However, by the judicious introduction of steel bars, objectionable contraction cracks can be entirely eliminated.

The water works engineer or superintendent is particularly interested in the subject of waterproofing concrete. It has been shown that wet concrete is more dense and consequently more impervious than dry concrete and that concrete becomes more or less porous as the quantity of cement is increased or diminished. A smoothly troweled surface produces a water-tight film or skin. It has also been found that slaked lime added to the concrete mixture helps to make it less permeable. The lime does not injure the cement in any way, although retarding the setting. Coal tar, pitch and asphalt mixtures applied on concrete are used with more or less success. A wash composed of one pound of lye, five pounds of alum and two gallons of water, applied with a brush and well rubbed in, has been used successfully on government fortifications.

A rich cement mortar plastered over concrete makes a very good waterproofing medium. Proper attention to these details will produce a water-tight structure, if there is not likely to be contraction cracks; but in works of any magnitude these are bound to occur, and they can be best provided against by the introduction of steel bars. A rich concrete properly reinforced, coated with plaster and troweled smooth makes an ideal waterprooff structure.

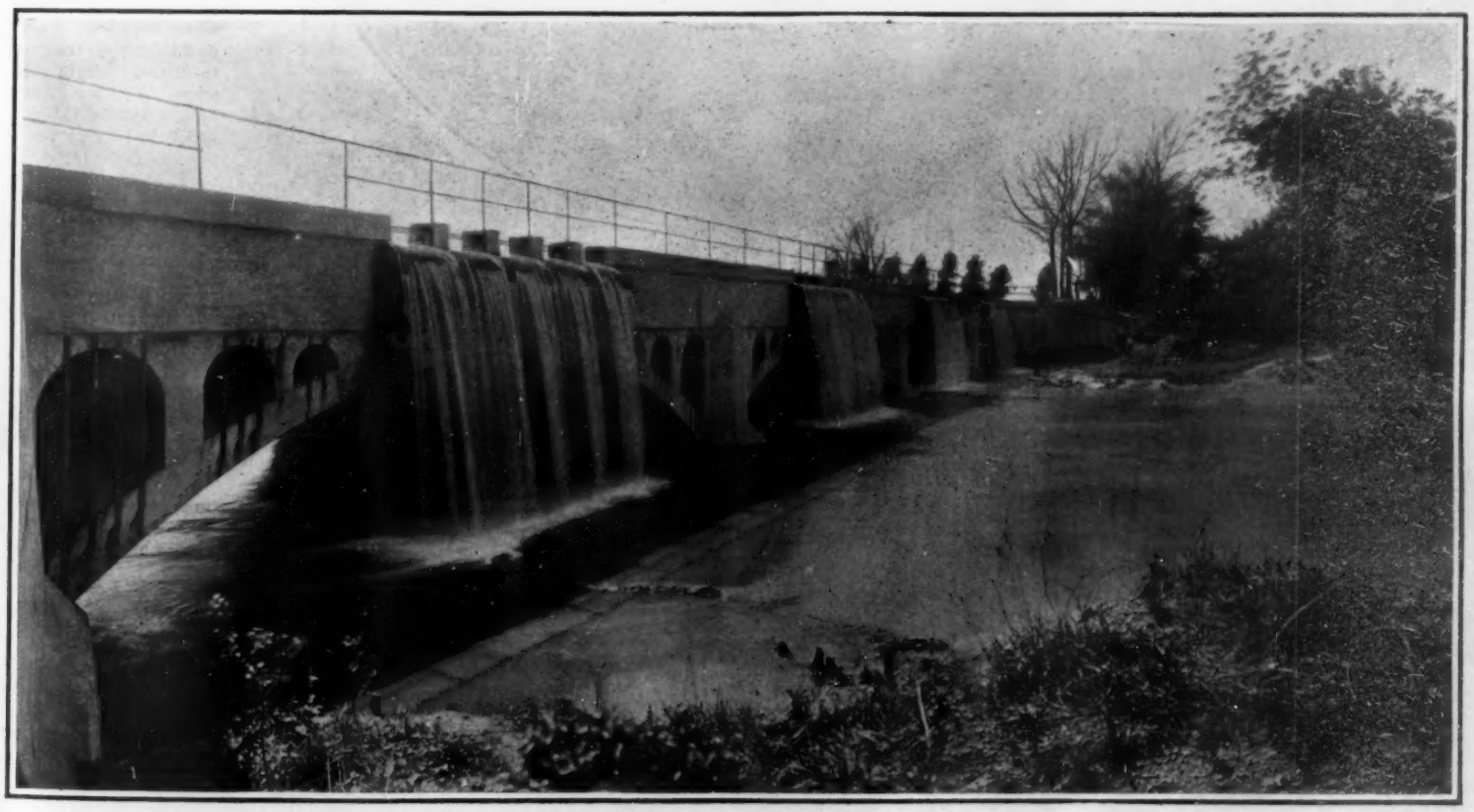


Covered reservoir under construction, showing the ground floor, the reinforced slab roof, and the supporting columns.

The Daylight Efficiency of Artificial Illuminants.

In a recent publication of the Bureau of Standards, Mr. H. E. Ives suggests that there is need of some method of estimating the resemblance of artificial illuminants to daylight, that is, of determining their daylight efficiency. Assuming that, by the extraction of certain qualities of light in an illuminant its color could be brought to resemble that of daylight very closely, the daylight efficiency of a source might be expressed in the form (intensity of available white light)/(total intensity of source). Mr. Ives suggests two methods of studying this question. The first is based upon the use of suitable absorbing screens which, as explained above, could be used to bring the color of an illuminant into near agreement with daylight, though reducing its intensity in doing so. Mr. Ives presents some spectrophotometric curves of various sources of light, and a diagram illustrating the amount and nature of light from the various sources which must be absorbed to produce white light. He also tabulates the "daylight efficiency" of a number of artificial illuminants. The method, however, is of practical rather than of scientific interest since it depends upon the particular wave-length for which the intensity is assumed to be unity, when plotting the spectrum curves. In addition, "selective" sources such as the mercury arc lamp, which yields a spectrum consisting of isolated bright lines, would work out to zero efficiency according to the above method. Yet, if we judge by sensation such sources contain a certain amount of white light. Mr. Ives then proceeds to discuss a second method based on the fact that any color can be matched by a mixture of white light and one ray of the spectrum. The ratio of the white light used in attaining such a match to the intensity of the source studied is then regarded as an alternative method of defining white light efficiency, which Mr. Ives in this case terms "white sensation efficiency." He points out that classification on this method gives rise to materially different results from those arrived at by the former method. The efficiency in the case of the second method appears to be higher. Yet the result gives no indication of the ability of the source to reveal colors of surrounding objects, and merely indicates the color of a white surface illuminated by the source. In conclusion, Mr. Ives remarks that the first method is preferable from the practical standpoint, and the latter from the purely scientific one.

It is estimated that the Gold Coast and Ashanti could supply 60,843 logs of mahogany and cedar per year if the internal communication were better. With mechanical haulage, such as traction engines and light tramways, the output could be increased to some 250,000 logs per annum without depleting the natural reserves.



Aqueduct by which the water is conducted to the filter plant of the Indianapolis water works.

The architectural possibilities of reinforced concrete are shown in this graceful, arched aqueduct.

REINFORCED CONCRETE WATER WORKS CONSTRUCTION.

THE HEAVENS IN MAY

BY HENRY NORRIS RUSSELL

IT is seldom that so much of interest to the amateur astronomer happens in a single month as in the one which is just before us.

First and foremost, of course, is the return of Halley's comet to the position where it is seen to the best advantage. Early in the month it is favorably placed for observation before daybreak; on the 18th it passes directly between us and the sun; and later it appears to even greater advantage in the evening sky.

At the beginning of May the comet is about 74 million miles away, but it approaches us rapidly, its distance diminishing to 41 million miles on the 10th, and 27 million on the 14th. As it was about at the limit of visibility to the naked eye on April 12th, while still 135 million miles from us, it is now a fairly conspicuous object.

The planet Venus is fortunately near by and serves as an excellent "pointer" to the comet. Anyone, however little familiar with the heavens, can easily find the latter by observing the following directions:

Choose a window from which the eastern sky is visible clear down to the horizon. Rise about 3:15 A. M. and look due east. The very bright starlike object, low down in the sky, is Venus. The comet is to the left of this and a little higher up at a distance about as great as the length of the bowl of the Great Dipper. It will probably be rather fainter than the four stars, forming a great square, which lie above and to the left of Venus, about twice as far away as the comet.

These directions hold good from May 1st to May 12th. On the 14th the comet will be on a level with Venus, and a little farther to the left. On the 16th it will be much lower than the planet and about 20 deg. to the left. After this the comet, or at least its head, can hardly be seen clear of the morning twilight.

It will be very interesting to watch the comet grow larger and brighter night by night as it comes nearer to us. How long its tail will be it is impossible to predict. The best time to see this, however, will in any case be from the 7th onward, when the moon is out of the way and the sky dark. The comet will be larger and brighter, too, at this time than previously.

Even after the head gets too near the sun to be seen, the tail may be observable in the mornings of the 17th and 18th extending upward and to the right from the eastern horizon, perhaps broad and fan-shaped, from the effects of perspective, since the end of it will be much nearer us than the head.

On the evening of the 18th or morning of the 19th (according to the observer's longitude) the comet passes between us and the sun, and the earth will be enveloped in its tail if the latter is long enough (over 15 million miles).

If this evening is clear it will be of great interest and importance to look for illumination of the sky. In the early evening, just after sunset, the comet's tail will be in the east, but a few hours later it will have passed over toward the west. If, as is sometimes supposed, the tail is a hollow cone of light, there will be two times at which the sky in general is comparatively brightly illuminated, separated by an interval while we are in the darker center of the tail. Meanwhile, observers on the opposite side of our planet will have the rare privilege of seeing the sun through the comet's head. Only the extreme western portion of the United States is included in this favored region, but as the comet enters upon the sun's disk at 6:22 P. M. by Pacific standard time and remains on it till 7:22, the transit will be visible all along the coast. The comet passes almost squarely across the center of the sun from west to east.

Paradoxical as it may seem, it is probable that the ordinary observer, even with a small telescope and dark glasses, will not be able to detect even the slightest trace of the comet's passage. With powerful instruments the nucleus, if solid, might be seen as a dark speck against the sun, if it is over 50 miles in diameter; but it is improbable that it is anything like so large, for, as has already been stated in these columns, the whole amount of light reflected from the comet, when remote from the sun, is no more than a single mass 30 miles across would send us.

It is possible, too, that the absorption of the gases composing the envelopes of the head and the tail may be detected by means of the spectroscope, and as we will be looking through the tail lengthwise, nearly 15 million miles of it will be there to exert any possible effect on the sun's light. Even so, it will not be surprising to many astronomers if nothing unusual is detected.

Such negative results will however be scientifically valuable, since they will enable us to say that the materials composing the comet do not exceed certain limits of mass or density.

Transits of comets across the sun are very rare. The most remarkable previous instance is that of the great comet of 1882, which, though so bright that it could be seen close to the sun in broad daylight with the naked eye, vanished completely when in front of the sun's disk, showing that it was practically perfectly transparent.

On the evening of the 19th we may perhaps already see the comet's tail in the evening sky, though its head will set while the twilight is still very strong. On the 20th, however, it will be visible till about 9 P. M., on the 22nd till 10:20, and on the 25th and afterward until after 11 P. M.

On the 21st the comet's head will be close to the star γ Geminorum; on the 23rd about 10 deg. above Procyon; and on the 25th near ϵ and ζ Hydrae. Fuller details will be given later.

This month is also notable for two total eclipses of the sun on the 8th and of the moon on the 23rd. The former is an important eclipse, the maximum duration of the total phase being over four minutes; but unfortunately the track of the shadow lies almost entirely in the Southern Ocean, only crossing the southern half of Tasmania, so that few stations are available for observers. As a partial eclipse it is visible throughout Australia, New Guinea, and the neighboring islands.

The lunar eclipse of the 23rd is of more interest to us, being visible throughout the United States, excepting Alaska. The moon enters the earth's penumbra at 9:32 eastern standard time, and first touches the shadow at 10:46. At nine minutes after midnight she disappears in it completely, and does not emerge till 1 A. M. At the middle of the eclipse, however, her southern edge is only about 200 miles inside the shadow, so that it will be considerably illuminated by sunlight refracted through our atmosphere. At 2:22 A. M. the moon takes leave of the shadow entirely, and at 3:36 of the penumbra. This eclipse will be of importance to observers on the Pacific coast, as it will give them a chance to photograph Halley's comet on a dark sky. The comet will have set for us in the east before totality comes on.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9½ o'clock: April 30.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 22.

NIGHT SKY: APRIL AND MAY

We may note the bright star Spica, a spectroscopic binary at a great distance from us, and the double star γ (now close to Jupiter) which is now separable with a small telescope, but in 1835 could hardly be seen double with the largest instruments then existing. The two components were then at the closest point of the very eccentric orbit, in which they revolve about one another in some 180 years.

THE HEAVENS.

With so much else to engage our attention, our glance at the stars must be short. The most prominent constellations in the west are Gemini and Canis Minor; in the northwest, Auriga, due north, Cassiopeia below the Pole, Ursa Minor and Draco above, and the Great Bear almost overhead. In the northeast Lyra is prominent, and in the east Hercules, Corona, and Boötes. Scorpio is rising in the southeast. Due south is Virgo. As our initial shows, there is not the slightest resemblance in the stars to the figure for which they were named.

THE PLANETS.

Mercury is evening star until the 25th, when he passes through inferior conjunction, between us and the sun, and becomes a morning star. He can be best seen at the beginning of the month, when he sets more than 1½ hours later than the sun. At this time he is in Taurus between Aldebaran and the Pleiades, and should be easy to see.

Venus is morning star, rising a little after 3 A. M. and exceedingly conspicuous all through the month. Mars is evening star in Gemini, setting about 10:30 P. M. in the middle of the month, at which time he is quite close to the star ϵ Geminorum (shown on map).

Jupiter is well past opposition, but is visible most of the night, remaining in sight till nearly 4 A. M. on the 1st, and till a little before 2 A. M. on the 31st.

Saturn is morning star in Aries, rising about an hour earlier than the sun in the middle of the month and two hours at its end; but it is too low to be conspicuous.

Uranus is in Sagittarius, and comes to the meridian at 4 A. M. on the 19th. Neptune is in Gemini, observable most of the night. On the 29th he is in conjunction with Mars, being 1 deg. 59 min. south of the latter. This may be a good chance for amateurs with

(Concluded on page 383.)

NATURE AS AN INVENTOR

BY PERCY COLLINS

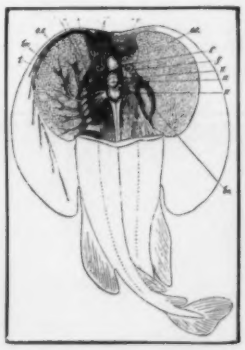
Civilized man justly prides himself upon his numerous inventions and mechanical devices, but it is possible that inventors in general would boast less of their achievements did they realize that the patents in which they have established their rights are really nothing more than modern reproductions of devices which have been employed by Nature from the beginning of time. It is a fact that there is scarcely an invention of man that has not its prototype in Nature. Sometimes these prototypes are of a rough-and-ready character. More often, however, they have been brought to the highest pitch of perfection. It is little short of amazing that primitive man should have remained blind, through so many centuries, to the significance and value of these inventions of Nature. It has been said that almost all of man's achievements as an inventor have their prototypes either in the animal or vegetable kingdom. Obviously, therefore, it would be impossible to attempt—in the limits of a short article—anything approaching a complete catalogue of these coincidences. Yet a few of them may be selected, almost at random; and they will serve to show how, after much labor and thought, man has perfected devices which at the time appeared to him to be original, although in reality they were nothing more than reproducetions.

As a first instance we may take grasping tools—a whole tribe of implements ranging from surgical forceps and sugar tongs to gasfitters' pliers and the vast pincers by means of which great masses of white-hot metal are manipulated upon the giant anvils of our workshops. It is scarcely too much to affirm that, without such tools as these, art, science and manufacture would long ago have ceased to advance. The reader needs only to pause for a moment to realize how important a part is played by these familiar implements in the activities of human life; and when mankind first discovered how to make and use such things he must have benefited instantly. Yet all these tools have their parallels in Nature, and one is fain to imagine that some of these prototypes might still supply useful hints to modern toolmakers. Perhaps the most perfect example of the powerful pincer in Nature is the claw of a crab or a lobster. The power of the crab's claw is so great that a bite from a large crab will inflict a severe injury. It is related that fishermen who have been feeling for crabs in the recesses of the rocks at low water have occasionally had their hand seized by a large specimen, and being unable to liberate themselves, have been drowned by the returning tide. Among other pincer-carrying animals are scorpions; while the insects known as earwigs carry a dainty pair of forceps at the end of the body, and employ the tools for folding their ample and delicate wings. The opposable thumb and forefinger constitute, in effect, a most useful pair of pliers adaptable to many uses; and it is strange that man should so long have overlooked the lesson in mechanics which they teach. Shears and scissors are, of course, closely allied in principle to grasping tools, yet they have come to us only with the advance of civilization—no savage tribes having the least idea of them or their

(*Continued on page 383.*)

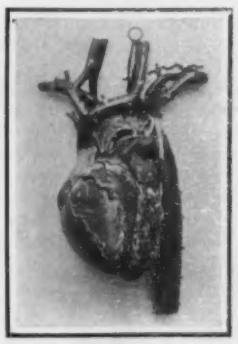
The first bottle—a gourd.

The first ball-and-socket joint—a human shoulder.



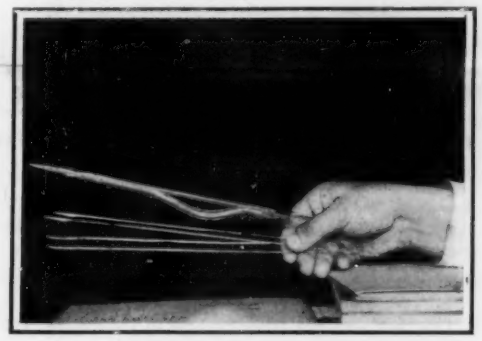
Nature's electric battery—the electric ray or torpedo.

The first spinners—a moth whose caterpillar spins the cocoon.



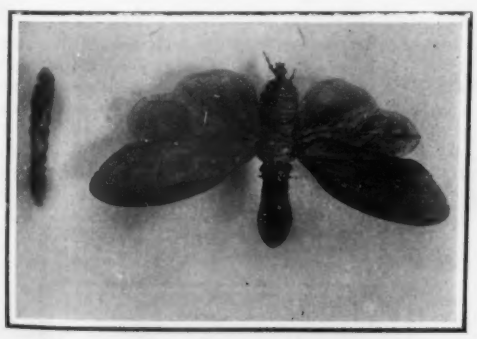
The first pump—a heart.

One of the first boxes, a receptacle which holds Brazil nuts, so cleverly packed that, if once taken out, no human hand can put them back again.



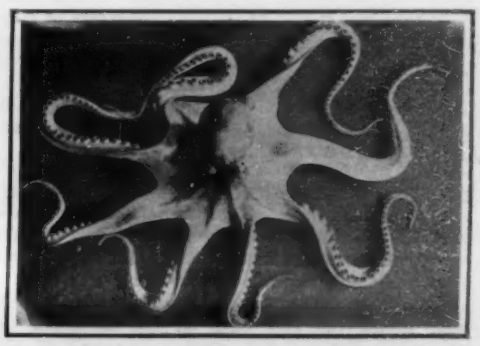
The first hypodermic syringe. The arrangement of lance and saws by which the female mosquito makes and enlarges a puncture. The instruments assembled form a tube through which venom is injected.

The first balloon—the "swellfish," which is said to inflate itself with air and skip over the water, impelled by the breeze.

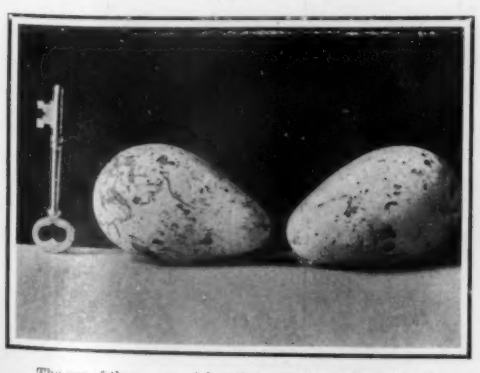


The lantern fly of tropical America. Light without heat—the illuminating engineer's ideal.

The first seamstress. The tailor bird, which stitches the leaves of her nest together.

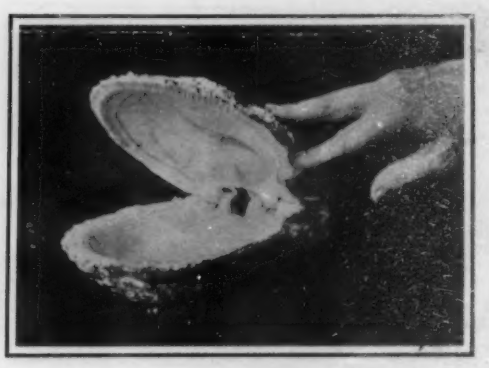


The first "cupping apparatus"—an octopus.



The egg of the murre. A box that cannot roll off a shelf. If disturbed it rolls around and around.

A lobster's claw. The original of a gas-fitter's pincers.



The first hinge. The thorny oyster of the Pacific, whose hinge is as good as that found in any hardware shop.

NATURE AS AN INVENTOR.

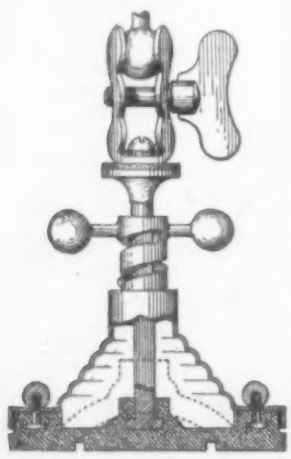
CURIOSITIES OF SCIENCE AND INVENTION

SUCTION BRACKET FOR MIRRORS.

There is nothing very novel in supporting a device on a smooth surface by means of a suction cup. However, the suction support illustrated in the accompanying engraving is provided with a very ingenious

SHAVING MIRROR ATTACHED TO A WINDOW PANE WITH SUCTION BRACKET.

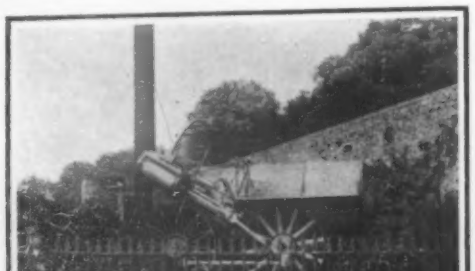
method of producing an efficient vacuum. The photograph shows a shaving mirror secured by means of a ball joint to the suction bracket and the bracket is supported on a window pane. So tightly does the device adhere to the window that it is possible to raise the window by lifting the bracket. The bracket cannot be pulled off the glass without danger of breaking the window pane. The line drawing shows a sectional view of the bracket, and illustrates the method of producing the suction. The base of the bracket is provided with a rubber disk, the center of which is secured to a square shaft on which the mirror is supported. Mounted on this shaft and free to turn thereon, is a sleeve in which a spiral groove is cut to receive a pin projecting from the square shaft. The sleeve is provided with a pair of ball knobs by which it may be gripped and turned, forcing the shaft outward and thus cupping the rubber disk as indicated by dotted lines. There is no possibility of leakage except under the edge of the disk. A bracket thus applied will adhere firmly for weeks at a time. The stand may be secured to any smooth surface and is particularly adapted for a shaving mirror because it may be placed directly on the window pane where the best light for shaving can be obtained.



THE MIRROR BRACKET BROKEN AWAY TO SHOW THE SUCTION DISK.

THE OLD "INVICTA" LOCOMOTIVE AS A MONUMENT.

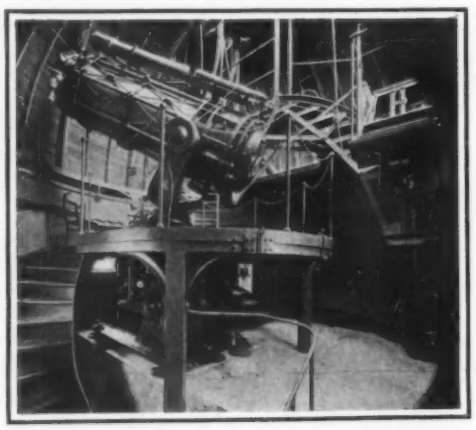
A public monument of interest to all who make a study of the evolution of the modern locomotive has recently been set up in Canterbury, England. Fixed on a pedestal beneath the Norman walls of the historic city is the old "Invicta" engine, which in May, 1830, hauled the first train on the Canterbury to Whitstable Railway—the pioneer iron-road of the south of Britain. The locomotive was built by George Stephenson. It will be observed that the cylinders and valve chests are very similar to those on the modern locomotive. The cylinders are 10 inches in diameter with an 18-inch stroke. The wheels are 4 feet in diameter. The boiler is 10 feet long by 3 feet 4 inches in diameter, and the working pressure was 40 pounds per square inch. The locomotive is now the property of the Corporation of Canterbury. It is coated with a special preservative paint.



GEORGE STEPHENSON'S "INVICTA" NOW SET UP AS A MONUMENT.

THE TELESCOPE THAT FIRST PICKED UP HALLEY'S COMET.

The large reflecting telescope illustrated herewith is interesting by reason of the fact that it was the first instrument to pick up Halley's comet on its present visit to our circle of the solar system. To be sure, the comet was discovered on photographic plates made with other telescopes before the photographic record made with the reflector here shown. But it was Prof. Max Wolf who first identified the comet on a photograph taken with this reflector at the Heidelberg Observatory. The discovery was made on September 1st, 220 days before perihelion. The Heidelberg reflector has a focal length of 9.18 feet, and the diameter of the mirror is 28 inches. The



THE TELESCOPE WITH WHICH HALLEY'S COMET WAS FIRST PICKED UP.

mounting is thoroughly up-to-date, and is electrically controlled. The observation platform is adjustable vertically by means of an electric motor.

A NEW COMPETITOR OF THE HORSE.

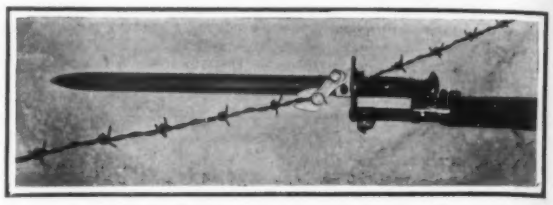
The "zebrass" has made its bow to the public. This creature is a new thing in the world, it never having existed until a year ago. It is the hybrid offspring of the African zebra and the Texas donkey. There are at the government experiment station at Bethesda, Md., six young zebrasses. Their sire is the royal Abyssinian zebra which King Menelik gave to

A VALUABLE HYBRID—A CROSS BETWEEN A ZEBRA AND A DONKEY.

President Roosevelt. The latter turned the striped creature over to the experiment station, and here the idea of developing a new race of animals was conceived. These six young ones are the nucleus. They are regarded as offering great promise. Certain of them combine the docility, strength and utility of the mother with the spirit, activity and beauty of the father. The yearlings are already larger than their mother. They are beautifully built and should be adapted to the many uses to which the domestic animal is put.

TROCHA CUTTER.

A soldier in the Spanish and Philippine wars, who had abundant experience in endeavoring to get through the wire entanglements of the Spanish trocha, has recently devised a very simple cutter which may be applied to the bayonet of the gun. A soldier in action will disencumber himself of everything except his gun



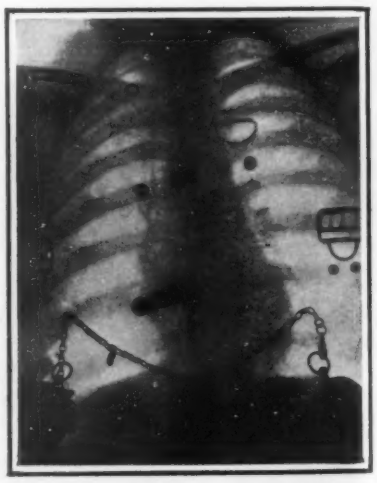
WIRE-CUTTING ATTACHMENT FOR GUNS.

and bayonet, and hence the pliers which are usually furnished for cutting barb wire obstructions are frequently thrown away, so that the only method of getting through an entanglement when encountered is to hammer the wire with the bayonet and a stone. Not only is this process slow, but it is fatal in a galling fire. For this reason the inventor has devised a cutter which may be secured to the bayonet without interfering with the use of the gun and which will operate to sever the wire by a single thrust of the weapon. As shown in the illustration, the cutter consists of two jaws pivoted eccentrically so that when extending forward in their normal position they are open, but when pushed back they close. In operation, the gun is inverted; the point of the bayonet is rested on the wire, and then the gun is thrust forward with the bayonet sliding on the wire so as to guide the latter between the jaws of the cutter. As the jaws are thrust back they close upon the wire and sever it.

RÖNTGENOGRAM OF A FULLY DRESSED MAN.

The range of visible rays from deep red to violet forms a very small part of the solar spectrum. Beyond the red, the rays are too long to affect the retina, but we can detect them as heat. At the other end, we have the ultra-violet rays which are too short to affect the retina, but manifest themselves on the photographic plate. Röntgen rays are not found in sunlight, but if they were, and if our eyes were so constructed that they could detect only these rays, visible matter about us would take on a very different aspect from that to which we are accustomed. The accompanying illustration shows how a man would appear. The man appears semi-transparent and one can easily make out his two watches and chain, his tie clip and the buckles of his suspenders. The metal parts of the buttons on his coat are also quite evident, and his ribs may be plainly seen. A pickpocket might envy such power of discernment, but he would have difficulty in concealing his plunder if others were possessed of similar vision.

The photograph was taken instantaneously with a Snooks apparatus, and is reproduced from "Archives of the Röntgen Ray." Heretofore, it has required a long exposure to take a photograph with the Röntgen rays, but recently a system has been devised by which a very sudden and powerful discharge is produced capable of making an instantaneous photograph. This sudden discharge is made by using a fuse in place of the interrupter of an induction coil. The fuse is melted when the proper intensity of current is reached, producing a very sudden break of the primary and a powerful discharge of the secondary. Exposures of 1/50 to 1/120 of a second have thus been obtained.



The Sketch.

RÖNTGENOGRAM OF A FULLY DRESSED MAN.

It is Easy to make advertising

claims for cars; but to make cars that will make good the claims is hard.

We ask automobile buyers to do this: After the advertisements have attracted your attention, then in fairness to yourselves and all the manufacturers, compare the cars *point by point.* That is all we ask.

There are Chalmers dealers in all parts of the United States—more than 200 of them. We suggest that you get in touch with the one nearest to you at once. Let us send you his name if you do not know him.

Chalmers "30" $1500

Judged by price alone you might as well buy some other car as a Chalmers: $1500 is simply $1500—no more in one bank than in another, no more in bills than in coin, no more in your pocket than in another man's.

It is only when you begin trying to buy something with your money that the sense of value enters your mind.

Your $1500 is worth more than another man's $1500, if at all, only because you are able to buy more with yours than he can buy with his.

We believe that when you buy a Chalmers "30" your $1500 becomes worth more than $1500 invested in any other car. Careful investigation will convince you of this fact.

Please remember you are not buying a *price* or an *advertisement:* you are buying a *car.* Therefore examine the *car* on its merits.

If you investigate thoroughly a Chalmers will be your *first choice,* if you are able to get a delivery in your territory.

* * *

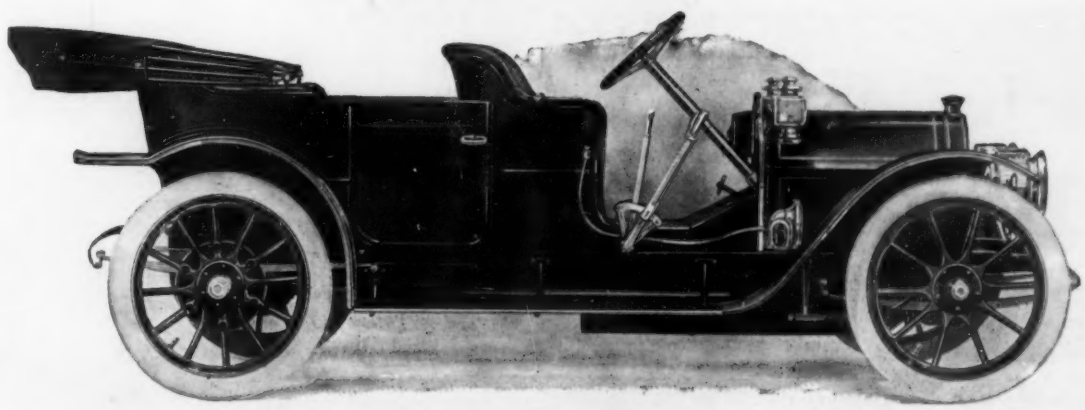
It is difficult to get more in a car, at any price, than you can get in a Chalmers "Forty" at $2750. The "Forty" has all the power one can want, the quality to endure, beauty of line and luxurious finish. Seats for seven if desired. **Catalogue "R" on request.**

CHALMERS-DETROIT MOTOR CO. DETROIT, MICH., U. S. A.

Chalmers Motor Company

Licensed under Selden Patent

Detroit, Mich., U. S. A.



Chalmers "30" Touring Car and Roadster, $1500
Pony Tonneau, $1600 Inside Drive Coupe, $2100 Limousine, $2750

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

SAFETY DEVICE FOR ELECTRIC LAMPS.—C. W. EISENMANN, Kansas City, Mo. The invention refers to safety devices for use in incandescent lamps using filaments or other incandescent members; the more particular object being to continue the activity of the lamp in case a filament or its equivalent is broken, which would ordinarily extinguish the light altogether.

Of Interest to Farmers.

THRESHING-MACHINE FEEDER.—H. J. BOYER, Chester, Mont. The principal purposes here are to provide a spreading and feeding table for delivering to the draper of the machine the grain-bearing straw to be threshed; to provide a portable spreading and feeding table adapted to deliver the straw upon the draper of the machine as and when extended in opposite directions from the machine; and to provide a mechanism wherein the construction and arrangement are simplified.

HARVESTER.—G. A. TUTTLE, Richland, Wash. This improvement has in view the provision of a harvester so constructed and arranged that it may be operated with a minimum amount of labor to cut the grain and transport it to threshing means, where it is threshed and thereafter separated from the straw and chaff, the latter being carried to a straw dump and the grain carried to an elevated position where it is delivered into bags and the like.

PEA-HARVESTER.—G. E. PRITCHARD, Lilly, N. C. In this instance the invention relates to machines for harvesting rice and the like, either from vines or stalks. It is of that type of device which is adapted to rake over the rows of plants, scoop in the vines, strip the peas or rice from the plants and then separate the peas or rice from the refuse.

COTTON-CHOPPER.—L. A. LANG, Southmayd, Texas. In operation the machine is moved through the field with a wheel on each side of the cotton row. When in position the clutch sleeve is released, thus coupling the operating means for the swinging arm with the wheels. The arm is swung transversely of the row. By means of a lever the swinging frame and with it the swinging arm and the hoes may be lifted clear of the ground, or adjusted to engage the plants whether above or below the plane upon which the wheels travel. Means provide to leave the standing plants nearer together or farther apart.

Of General Interest.

PRESS-BED.—F. C. LEETHEM, Middletown, N. Y. The aim in this instance is to provide a bed having a construction which will enable printing plates to be set up thereupon at any desired point, and further, to provide an arrangement which will enable the plates to be unlocked or removed at any point without affecting the "lock-up" of the entire bed.

BOILER BOTTOM.—D. J. LAHAY, Coleman, Wis. The intention in this improvement is the provision of a false bottom with an improved construction which can be readily inserted in an ordinary clothes boiler so as to enable it to be used as a steam cleaner for cleaning lace curtains, and other delicate fabrics.

BRUSH.—J. L. ERSKINE, New York, N. Y. The brush is made in sections capable of being readily taken apart for cleaning, sterilizing or renewing any one of the sections in case the same is worn out or injured, thus saving the cost of a new brush. Means provide for the ferrule being relieved of some strain when the brush is used, and this insures a strong and durable brush.

AMMONIA-PURIFIER FOR REFRIGERATING PLANTS.—L. WAGNER, Sedalia, Mo. The object of the invention is to produce a high grade of anhydrous ammonia continuously while the compressor is in operation, and to accomplish this by condensing and separating out the oil and water vapor carried along with the ammonia from the compressor.

INDEX.—R. W. WOOD, Seattle, Wash. An object of this inventor is to provide an index by the use of which a word may be readily indexed up to its third letter, the book or cards of a card index or ledger being conveniently arranged for reference. Still another object is to arrange figures on the leaves or cards so that the user can quickly turn to the page or card of the desired number.

Hardware and Tools.

HAMES-FASTENING DEVICE.—J. W. GONCE, Chattanooga, Tenn. The main object of the present invention is the provision of a simple, durable and efficient fastener for collar hames, one in which the adjustment of the hames shall be easy and rapid. It is an improvement on the fastening for hames that consisted most usually heretofore, in a strap passed through loops on the lower end of the hames metal, while the upper end has been drawn together by cinch thongs.

HORSESHOE-CALK.—W. E. ABBOTT, Wilmington, Ohio. Mr. Abbott's invention is an improvement in horseshoe calks, and the object of the inventor is the provision of calks, either sharp or dull, which may be removed and replaced, without disturbing the shoe, and without recourse to a skilled mechanic.

Machines and Mechanical Devices.

BLOWPIPE.—F. L. MCGAHAN, St. Louis, Mo. The blowpipe is of the kind employed in connection with liquid and aeriform fuels, the more particular object being to provide for accurate adjustment in the relative supply of different aeriform bodies, and for causing the admixture of various aeriform bodies to take place thoroughly within the burner.

ROAD-GRADING MACHINE.—C. W. HORTON, Belle Rive, Ill. Among the principal objects which this invention has in view are: to provide a construction whereby a grader may be controlled to operate over an increased area; to provide a structure wherein the operating angle of the grading blade may be adjusted; and to provide a structure simple and durable.

AIR-SHIP.—G. H. BREKKE, Seattle, Wash. Primarily this invention has in view, a dirigible flying machine of simple and practical construction under easy and positive control of the operator. The machine is of that type which depends on propellers for suspending it in the air, and is more especially designed for carrying the operator only.

DRILL.—J. P. TYE, Rochester, Texas. The invention relates to well-drilling machines and is intended to provide various improvements in the manner of actuating the drill rope and controlling the general operations of the machine. It includes novel means for throwing into or out of gear the power operating mechanism and instantaneously hinging the parts into position for operating the drive shaft by means of a hand wheel provided thereon.

CAN FEEDING AND DELIVERING MECHANISM.—J. W. WHITE, Kansas City, Kan. Generally speaking, the invention consists of a chute, can-filling mechanism connected to the chute, a rotatable table, can-feeding means connected to the table, sliding carriages on the table adapted to remove cans from the chute and so place them on the table that they will be located in communicating relation with said feeding means connecting to the table.

Prime Movers and Their Accessories.

ENGINE-GOVERNOR.—L. E. HUNT, Somerset, Ky. The object here is to provide an efficient governor for engines of various types, by means of which the flow of motive fluid such as steam, compressed air, water, or gas to the engine can be controlled, in which the governor itself can be employed to start the engine, which is positive in its action, and which controls the passage of motive fluid to the engine with certainty. Mr. Hunt has used this governor in his shops and on several neighboring saw-mill engines where they have given results superior, he claims, to old style standard governors.

Railways and Their Accessories.

RAILWAY TIE AND CLAMP.—A. M. WAGNER, Pendleton, Ind. The aim in this patent is to produce a tie adapted to be formed of metal and provided with means for supporting and clamping the rail. The special aim is to provide a construction having few parts, and to provide also for giving the rail a certain amount of desirable resiliency under a passing load.

RAILWAY-CROSSING.—E. MCKEE and B. H. COURSEY, Ashley, Ill. One of the objects of the invention is to provide a simple device which may be automatically operated by the moving train itself or which may be operated by hand, as from a switch tower or other convenient place as desired, for closing the transverse slot so that the wheels of the train may have a continuous bearing surface.

RAIL-JOINT.—C. E. BISER, Selma, and W. W. MCCRAE and J. E. MCCRAE, Birmingham, Ala. In the present patent the invention is in rail joints. The joint is arranged to be very strong, firm, and safe and will be practically noiseless, insuring smooth running of the rolling stock, and eliminating jar, thus adding to the comfort of the traveler, and also to the life of the rail and the road bed.

Pertaining to Recreation.

CARD-DEALING MACHINE.—R. A. BERGER, New York, N. Y. The aim in this case is to provide a machine, arranged to permit accurate and quick dealing of the cards one by one, without the cards being handled or touched by the dealer, thus preventing cheating, and as the cards are not touched by the dealer, soiling thereof by wet fingers is prevented, thus keeping the cards in a sanitary condition.

INCLINED RAILWAY.—A. F. SMITH and A. T. SMITH, Longbeach, Cal. The intention here is to provide a railway for use in pleasure resorts, exhibitions and like places, and arranged to provide a continuous track for a suspended car to travel on, the track having an up-track, a spiral down-track, and a return-track with the lower or starting end of the up-track.

Pertaining to Vehicles.

SECURING DEVICE FOR WAGON END-GATES.—L. HILLAN, Wentworth, S. D. The purpose of this inventor is to provide a securing device for the cross bolt that holds an end gate in place, enabling the instant release of the threaded end of the cross bolt, for its removal, and also for quickly effecting an attachment of the nut that engages the said end of the bolt.

DEMOUNTABLE RIM.—E. J. BUSHEY, New York, N. Y. The improvement pertains to wheels for automobiles and other vehicles, and the aim is to furnish a demountable rim, arranged to permit quick and convenient removal and with it the inflatable tire, and replacing of the rim by another whenever it is desired.

FOLDING GO-CART.—M. FOLGEMAN and A. KRAUS, New York, N. Y. The invention has for its purpose to provide a cart in which the wheels, springs, hood, and other similar parts may be folded in the body, which may be so closed that it will resemble a dress-suit case, means being provided to secure releasably the wheels, springs, hood, etc., in operative position.

Designs.

DESIGN FOR A COVERED DISH.—L. ROUQUART, New York, N. Y. In this design for a covered dish the ornamental effect is produced in a body formation of dish that tapers down from the top to a flanged and footed base. The cover lines correspond with those of the body portion, and converge at the cap or lifter. Handles are placed at each end of the dish.

DESIGN FOR A HAT-PIN.—H. W. SCHWALB, New York, N. Y. The design includes the usual long and pointed pin, and at its head is a ball of relatively small circumference. From the ball hangs a pear-shaped and exquisitely designed drop many sizes larger than the head of the pin.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our **Hand-Book** on Patents will be sent free on request.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending April 26, 1910,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acetylene generator and torch, A. F. Jenkins 956,358
Acetylene generator and torch, A. F. J. Johnson (by judicial change of name now A. F. Jenkins) 956,359
Acid, concentrating and purifying sludge, Blacher & Szteneel 956,276
Acid from acid sludge, obtaining sulphurous, Schildhaus & Condren 956,184
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THE HEAVENS IN MAY.

(*Concluded from page 378.*)

telescopes of sufficient size to pick up the faint greenish disk of the planet.

The moon is in her last quarter at 8 A. M. on the 2nd, and is new at midnight on the 8th (during the solar eclipse visible in Australia). She reaches her first quarter at 9 P. M. on the 15th, is full during her eclipse on the night of the 23rd, and comes to the last quarter again at 5 P. M. on the 31st. She is nearest us on the 8th, and farthest away on the 21st.

During her circuit of the sky she passes close to Venus on the 5th (and likewise near the comet the same afternoon), to Saturn on the 7th, Mercury on the 10th, Mars on the 12th (pretty close), Neptune on the 13th, Jupiter on the 19th, and Uranus on the 28th.

Princeton University Observatory.

NATURE AS AN INVENTOR.

(*Continued from page 379.*)

use. Those admirable workers in skin, the Kaffirs and Eskimos, employ only knives. The idea of the knife edge in combination with the leverage afforded by tools of the grasping type had never occurred to them. Yet shears are exemplified by the jaws of many insects, as well as by those of tortoises and turtles.

Only of comparatively recent years has man made boxes in which to store money, trinkets, or other valuables. Yet Nature has had her boxes from time immemorial. Some of the most interesting of these take the form of seed-pods, as, for example, the stout casket in which Brazil nuts are packed. In this instance, too, the primitive idea of the puzzle—later elaborated by the Chinese, as well as by other races of mankind—seems to lie dormant; for here we have a vast number of nuts, so cleverly packed into their pod or casket, that if once they are taken out it is almost impossible for human hands to restore them to their place.

The hinge, as attached to a lid or door, has been known to man only for centuries, yet Nature has made use of it literally for billions of years. In proof of this statement, it is only necessary to indicate a bivalve shell, such as an oyster or a clam. We know from geologists that such shells are among the earliest indications of life upon this earth with which they are acquainted. The eggs of many insects, too, open with a very perfect little hinge; while the little lid which covers the cunningly contrived nest of the trap-door spider, is also hinged in a most ingenious manner by means of silken bands.

Savage man had no means of preserving light for himself after the setting of the sun, and it was only with the slow progress of civilization that he became inspired with the idea of artificial illumination. Yet this was not for want of examples set by Nature; for many animals carry about with them bright lights during the hours of darkness. Marine organisms, in particular, emit phosphorescent radiance, while many kinds of insects, to which such names as glow-worms, fireflies or lantern-flies have been applied, are highly luminous. In many instances the precise manner in which the light of these creatures is produced has baffled scientific inquiry. Still, the fact remains that Nature had her living glow-lamps ages before man emulated her example.

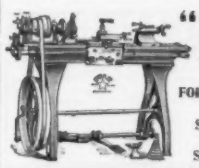
Formerly the surgical operation known as cupping was so constantly performed that scarcely any man attained middle age without undergoing it. The object in view was the removal of blood from some definite spot; the surgeon, by means of his apparatus, calling atmospheric pressure to his aid. Man might very well have invented this operation after examining the numerous suckers which stud the long arms, or tendrils, of an octopus. The principle involved is identical in each case. Indeed, many of man's most useful inventions depend for their efficiency upon the weight of the atmosphere and the creation of a more or less perfect vacuum. Like the old-fashioned cupping-glass, the well-known toy known as the "sucker," reminds us of the octopus. By means of the sucker—a small circle of moist leather with a string attached—large stones may be lifted in exactly the same manner that the octopus dislodges rocks, or holds down its struggling prey. That comparatively modern invention, the pneumatic peg, is an almost identical device. The apex of the peg is fitted with a sort of a cup made of India rubber. When this is pressed upon a smooth, flat surface, such as a pane of glass, the air is forced out of the cup and a vacuum formed. The pressure of the atmosphere then causes the cup to adhere to the glass with sufficient force to enable objects to be suspended from the peg. Further, the man who had studied the octopus might have added to the inventions already enumerated, that of the common pump, which raises water simply by the action of the atmosphere.

That well-known device, the ball-and-socket joint, without which many of our instruments and tools would be clumsy and impracticable, has many prototypes in Nature. Perhaps the most familiar of these is seen in the articulation of the human shoulder bones—or, indeed, in the bones of many animals, for the marvelous flexibility of the snake is rendered possible only because the vertebræ of this reptile constitute a long chain of balls and sockets beautifully adjusted one to the other. Another very perfect example of ball-and-socket movement is found in the case of the sea-urchin. Each of the spines with which the shell of this creature is covered is swollen at the base into a cup-like form, and this cup fits accurately upon a little rounded prominence of the shell, which exactly fits into the cup, just as the ball of the human thigh-bone fits into the acetabulum. The legs of insects, in their articulation to the body supply examples of the ball-and-socket principle too numerous to mention.

The idea of the flask or bottle is eminently natural—i. e., it has played a part in the economy of Nature from time immemorial. Perhaps the most remarkable examples are to be found in the vegetable kingdom among the plants known as gourds, the seed-vessels of which assume forms calculated to remind the least imaginative individual of antique pottery.

We have already seen that the theory of the common pump might have formulated itself in the mind of man after he had studied the habits and structure of the octopus. There is, moreover a prototype in Nature for that far more complicated device known as the force-pump. This prototype is the human heart. Anatomists agree that it is constructed on principles which are marvelously up-to-date. In an incredibly short period, the whole of the blood in the human body passes to the heart and is driven from it again with a force which carries the stream to the tips of the fingers and toes; while as everyone knows, the action of the heart persists, night and day, throughout the whole life of a man. If we regard the heart as the prototype of a force-pump wrought in metal by the hands of mankind, we must still be impressed by its immeasurable superiority. Its renovation and repairs are affected while the mechanism is in rapid motion.

The simplest form of sewing is that which is in vogue among such primitive races as the Eskimos and Kaffirs. It consists in boring holes through the material which is to be joined together, and pushing the thread through them. The reader will observe that the operation is of so rough-and-ready a character that no needle is required; and one is almost tempted to imagine that mankind might actually have copied this method of sewing from having observed the manner in which the tailor bird constructs its nest. Be this as it may, the fact remains that this bird actually sews leaves together by their edges, and makes its nest within



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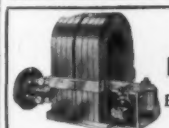

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the pocket-like receptacle thus formed. Its method of working resembles exactly that which has been detailed above. First the sharp-pointed beak is used to form a slit or hole in the leaf, and through this a piece of tough grass, or other vegetable fiber, is passed. A second hole is made and the natural "thread" is drawn through it; and so on until the work is completed by a tucking in and adjustment of unruly ends. Should the reader care to visit a museum, and make a mental comparison of stitches made by savage tribes and those formed by the tailor bird, he will frequently discover that the latter are far less clumsy than the former. In a word, it may be asserted without fear of contradiction that mankind was not first in the field where the art of needlework is concerned. The sewn seam is another of Nature's own contrivances.

The arts of spinning and weaving have also their prototypes in Nature. The majority of nest-building birds exhibit a more or less strongly marked weaving instinct. This instinct is most strongly developed in the case of a genus of finch-like birds indigenous to the warmer parts of Asia and Africa. The spinning of fine threads so as to form thicker strands and the combination of these into webs, are operations characteristic of many insects and their allies. Many spiders, as everyone knows, construct silken webs which they employ as a means of capturing their prey, or of protecting their egg-clusters from injury. But it is among insects of the sub-order *Heterocera* (i. e. the moths) that the spinning of silk has been brought to the highest state of perfection. Moths, indeed, may with justice be termed the first spinners—the inventors under the guiding hand of Nature of this invaluable art. Take, for example, the cocoon of the well-known Cecropia moth—the so-called American silkworm. It is entirely constructed of silk, which is secreted by glands in the mouth of the grub or caterpillar. As soon as the insect has become full-fed, and is about to pupate, it sets about the formation of its cocoon and labors unceasingly until it is completed. The exact method of construction is so intricate that considerations of space forbid us to describe it in detail. Suffice it to say that the caterpillar first constructs of silken threads a kind of scaffolding, or framework; and then—laboring from within—goes to and fro about the skeleton structure depositing its endless silken thread by means of a figure of eight movement of its head. In this way a kind of tent of marvelous toughness is built up, wherein the caterpillar changes to a chrysalis and passes safely through the quiescent period of its existence, to emerge eventually as an adult moth.

In passing, the reader may be reminded that many kinds of caterpillars contrive a kind of trap at the mouth of their cocoons similar in principle to those made by man for the capture of crabs, lobsters, and eels. Within the neck of the Emperor Moth's cocoon, for example, there is a conical arrangement of stout, bristly appendages, which form a well-nigh impenetrable barrier against the attacks of enemies which may attempt to force an entrance from without. Yet owing to the flexibility of these appendages, the fully developed moth can push its way out of the cocoon with perfect ease. If the reader has followed this description carefully, he will perceive that the trap of a moth's cocoon is a veritable reversed counterpart of the familiar lobster-pot—a device which is employed by fishermen in many parts of the world.

The writer is not aware whether Nature's contrivance of a box that cannot roll off a shelf has ever been put to practical use by mankind. It is obvious, however, that such a device might very well form the basis of more than one valuable invention. The principle may be studied by all those who are able to visit the rocky ledges used by sea-fowl as breeding places—or, indeed, by those

(*Continued on page 386.*)

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Lubricator, J. H. Searle. 956,436
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(*Continued on page 385.*)

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Inquiry No. 9066.—Wanted complete outfit for export for making rice-flakes and wheat-flakes.

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Inquiry No. 9074.—Wanted, to buy old model locomotives or steamboats, such as were exhibited with nickel-in-the-slot attachments in ferry-houses, etc.

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Inquiry No. 9078.—Wanted, the address of manufacturers of sewer pipe, made of fiber and asphaltum, suitable for laboratory use.

Inquiry No. 9080.—Wanted the address of parties manufacturing paste-making machinery.

Inquiry No. 9083.—Wanted, the address of firms manufacturing small beer brewing plants, from 75 to 100 gallons a day.

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Inquiry No. 9092.—Wanted, the address of some firms who manufacture permanent lamp wicks.

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Inquiry No. 9095.—Wanted, name and address of the manufacturer of the duplex revolving pencil sharpener.

Inquiry No. 9096.—Wanted, the address of manufacturers of spiral welded pipes, possessing great strength.

Inquiry No. 9097.—Wanted, address of makers of impulse water wheels.

Inquiry No. 9098.—Wanted, name and address of the manufacturers of the ozonizer.

Inquiry No. 9099.—Wanted, address of manufacturers of machinery for making wire cables.

Inquiry No. 9101.—Wanted, addresses of manufacturers of a dip or magnetic needle, for exploring for iron ore.

Inquiry No. 9104.—Wanted, addresses of manufacturers under the name of A. O. Co. Standard.

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Inquiry No. 9113.—Wanted name and address of the manufacturers of the Russell Patent Automatic Ink Well.

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Inquiry No. 9124.—Wanted, name and address of a company in Germany making a machine to manufacture a cement and asbestos shingle and building lumber.

Inquiry No. 9127.—Wanted, address of L. Dermigny, manufacturer of a family ice machine for $10.00

Inquiry No. 9131.—Wanted, information as to how or where I could get a sample of tin ore.

Inquiry No. 9132.—Wanted, manufacturers of a gasoline traction engine with a hoisting attachment; in other words, the machine will be used as a portable stump puller to pull sassafras roots, used in making oil of sassafras.

Inquiry No. 9134.—Wanted, a small hydraulic motor, capable of giving about one horse power, with a water power of 35 lbs. per square inch.

Inquiry No. 9135.—Wanted, name and address of manufacturers of the Parshall Compressed Air Ice Machine.

Inquiry No. 9136.—Wanted, the name and address of a skunk raising farm.

Inquiry No. 9137.—Wanted, a device that will braid leather strips for horse whips.

Inquiry No. 9138.—Wanted, the address of manufacturers of machines capable of forming a number (12 or more) of pieces of paste about 36 mm. x 32 mm. x 6 mm., made of lead oxide and sulphuric acid, and placing them into a frame having a separate compartment for each piece, the space between each piece and the next being all round 4 mm. The process could be somewhat similar to biscuit making.

Inquiry No. 9139.—Wanted, the name and address of some manufacturer of a coffee mill run by water motor.

Inquiry No. 9140.—Wanted, manufacturers of disc records for gramaphones that use a sapphire point instead of a steel needle.

Inquiry No. 9142.—Wanted an appliance used in ice chests to make ice last longer.

Inquiry No. 9143.—Wanted, name and address of the manufacturers of an air mattress.

Inquiry No. 9144.—Wanted, manufacturers of machinery for making soda water tubes, commonly known as straws.

Inquiry No. 9145.—Wanted, to buy machinery to load blasting caps or detonators.

Inquiry No. 9146.—Wanted, address of firms engaged in die cast work.

Inquiry No. 9147.—Wanted, manufacturers of machinery for making manilla rope and all kinds of ropes from fibre of century plants, such as maguey, agave, honiken, zaeviera or any such fibres.

Inquiry No. 9148.—Wanted, manufacturers of machinery for weaving bags of fibre, also manufacturers of machinery for separating fibres as above mentioned from their respective plants.

Inquiry No. 9149.—Wanted, manufacturers of machinery for roasting coffee for small and large industries.

Inquiry No. 9150.—Wanted, manufacturers of machinery for the manufacture of French heels for ladies' shoes.

Inquiry No. 9151.—Wanted, manufacturers of cocoanut oil machinery.

Inquiry No. 9152.—Wanted, the address of the Graham Safety Lamp Filler and Ventilator.

(Continued from page 384.)

Motors, cut-off for fluid pressure, J. H. Champ	956,287
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Nest, hen's, A. Jessup	955,882
Nightgown, J. R. Jones	956,102
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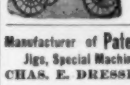

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Phoenix Silk Half-Hose are seamless. They are the first genuine cocoon silk half-hose to sell at 50c. The purchase of the silk output of several mills enables us to reduce manufacturing cost.
The exquisite, light, soft, lustrous texture of Phoenix Silk Hose is a decided contrast with the hard, coarse, common hose of mixed yarns that sell at the same price.
Phoenix Silk Hose are not mercerized cotton, or silk and cotton mixed, but every pair is guaranteed pure silk throughout.
Ask your dealer first for Phoenix Hose, but, if not easily obtainable, we will fill your order direct and give you an absolute guarantee that every thread of these socks is pure silk, or money refunded.
A trial will convince you of the excellent wearing qualities of Phoenix Silk Hose. You will never go back to common hose when you can get pure silk ones like the Phoenix for 50c a pair.
Can be had in the following colors: black, tan, maroon, green, grey, taupe, burgundy, navy and helio. Six pairs, plain or assorted colors, in handsome box, prepaid $3.00, or 50c per pair—sold with a positive guarantee for wear. If not as represented money will be refunded. State size and color wanted.
Phoenix Pure Silk Knitted Neckties to match hose, 50c each.
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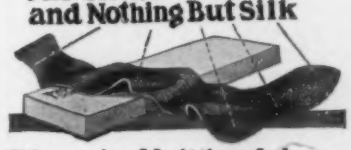

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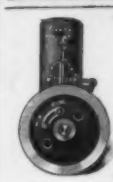

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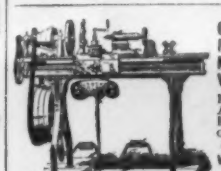

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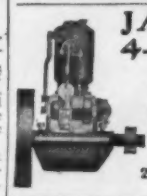

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the pocket-like receptacle thus formed. Its method of working resembles exactly that which has been detailed above. First the sharp-pointed beak is used to form a slit or hole in the leaf, and through this a piece of tough grass, or other vegetable fiber, is passed. A second hole is made and the natural "thread" is drawn through it; and so on until the work is completed by a tucking in and adjustment of unruly ends. Should the reader care to visit a museum, and make a mental comparison of stitches made by savage tribes and those formed by the tailor bird, he will frequently discover that the latter are far less clumsy than the former. In a word, it may be asserted without fear of contradiction that mankind was not first in the field where the art of needlework is concerned. The sewn seam is another of Nature's own contrivances.

The arts of spinning and weaving have also their prototypes in Nature. The majority of nest-building birds exhibit a more or less strongly marked weaving instinct. This instinct is most strongly developed in the case of a genus of finch-like birds indigenous to the warmer parts of Asia and Africa. The spinning of fine threads so as to form thicker strands and the combination of these into webs, are operations characteristic of many insects and their allies. Many spiders, as everyone knows, construct silken webs which they employ as a means of capturing their prey, or of protecting their egg-clusters from injury. But it is among insects of the sub-order *Heterocera* (i. e. the moths) that the spinning of silk has been brought to the highest state of perfection. Moths, indeed, may with justice be termed the first spinners—the inventors under the guiding hand of Nature of this invaluable art. Take, for example, the cocoon of the well-known Cecropia moth—the so-called American silkworm. It is entirely constructed of silk, which is secreted by glands in the mouth of the grub or caterpillar. As soon as the insect has become full-fed, and is about to pupate, it sets about the formation of its cocoon and labors unceasingly until it is completed. The exact method of construction is so intricate that considerations of space forbid us to describe it in detail. Suffice it to say that the caterpillar first constructs of silken threads a kind of scaffolding, or framework; and then—laboring from within—goes to and fro about the skeleton structure depositing its endless silken thread by means of a figure of eight movement of its head. In this way a kind of tent of marvelous toughness is built up, wherein the caterpillar changes to a chrysalis and passes safely through the quiescent period of its existence, to emerge eventually as an adult moth.

In passing, the reader may be reminded that many kinds of caterpillars contrive a kind of trap at the mouth of their cocoons similar in principle to those made by man for the capture of crabs, lobsters, and eels. Within the neck of the Emperor Moth's cocoon, for example, there is a conical arrangement of stout, bristly appendages, which form a well-nigh impenetrable barrier against the attacks of enemies which may attempt to force an entrance from without. Yet owing to the flexibility of these appendages, the fully developed moth can push its way out of the cocoon with perfect ease. If the reader has followed this description carefully, he will perceive that the trap of a moth's cocoon is a veritable reversed counterpart of the familiar lobster-pot—a device which is employed by fishermen in many parts of the world.

The writer is not aware whether Nature's contrivance of a box that cannot roll off a shelf has ever been put to practical use by mankind. It is obvious, however, that such a device might very well form the basis of more than one valuable invention. The principle may be studied by all those who are able to visit the rocky ledges used by sea-fowl as breeding places—or, indeed, by those

(*Continued on page 386.*)

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(*Continued from page 382.*)

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Firearm, automatic, L. Schmeisser. 956,430, 956,431
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Fluid motor, W. J. Morrison 955,896
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Folding box, J. A. Wagnitz 956,236
Foot rest, L. E. Fitzsimons 956,326
Fountain. See Drinking fountain.
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Fur treating device, M. Whitlatch 956,247
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Game, parlor base ball, H. A. Comstock. 956,291
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Garbage receptacle, J. P. & A. C. Urban. 956,454
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Gas burner, oil, C. C. Lillibridge. 956,114
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Gas light, inverted burner for incandescent, A. H. Humphrey 955,874
Gas, manufacture of, A. Zindler 956,019
Gas producer, S. B. Sheldon 956,199
Gas purifying apparatus, E. Schmiedt. 955,915
Gas retorts, charging upright, E. G. B. Kortling 955,970
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Glass articles, machine for making hollow, P. T. Sievert 956,505
Glass machine, continuous drawn sheet, L. A. Thomburg 956,449
Glass melting apparatus, J. W. Crulkshank 956,297
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Grain loader, S. L. Cornatzer 955,947
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Grinding mowing machine knives and the like, grinding rest for use in, W. Rawlinson 956,416
Hair pin box, B. E. Sawyer. 955,914
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Harvester, potato, C. W. Becker 956,272
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Hay press, J. S. Lafleur 956,111
Hay rack, C. Krogen 956,107
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Lamp socket, electric, V. T. Bailey. 956,265
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Latch, door, F. E. Bessler 956,273
Laundry iron, electric, E. H. Richardson. 956,174
Leveling mechanism for engineering and surveying instruments, Saegmuller & Grebe 955,911
Life sheet fender, automatic, M. L. Keizur 955,967
Lifting jack, J. H. Burkholder. 956,478
Link and making same, connecting, J. Merritt 956,394
Linotype machine, G. D. Hartley 956,344
Linotype machine matrix, G. W. Grasnick 956,337
Liquid meter, J. W. Ledoux. 956,374, 956,375
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Lock, H. G. Voight 956,004
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Lock, E. H. Jones 956,361
Lock indicator, coin-controlled, W. H. Kluge 955,969
Locomotive boiler, articulated, H. S. Vincent 955,927
Looms, compass board for, K. & J. B. Engsberg 956,321
Looms, thin place detecting means for, A. E. Rhoades 956,172
Lubricator, J. H. Searle 956,436
Mail delivering apparatus, J. H. Garman. 955,861
Manganates, permanganates, halogens, and hydroxids, producing, F. J. Machalske. 956,120
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Moistening device, W. J. Minkiewitz 956,129
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Motor and lazy tongs elevator, C. A. Schwarz 956,189

(*Continued on page 385.*)

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Inquiry No. 9135.—Wanted, name and address of manufacturers of the Parshall Compressed Air Ice Machine.

Inquiry No. 9136.—Wanted, the name and address of a skunk raising farm.

Inquiry No. 9137.—Wanted, a device that will braid leather strips for horse whips.

Inquiry No. 9138.—Wanted, the address of manufacturers of machines capable of forming a number (12 or more) of pieces of paste about 36 mm. x 32 mm. x 6 mm., made of lead oxide and sulphuric acid, and placing them into a frame having a separate compartment for each piece, the space between each piece and the next being all round 4 mm. The process could be somewhat similar to biscuit making.

Inquiry No. 9139.—Wanted, the name and address of some manufacturer of a coffee mill run by water motor.

Inquiry No. 9140.—Wanted, manufacturers of disc records for gramaphones that use a sapphire point instead of a steel needle.

Inquiry No. 9142.—Wanted, an appliance used in ice chests to make ice last longer.

Inquiry No. 9143.—Wanted, name and address of the manufacturers of an air mattress.

Inquiry No. 9144.—Wanted, manufacturers of machinery for making soda water tubes, commonly known as straws.

Inquiry No. 9145.—Wanted, to buy machinery to load blasting caps or detonators.

Inquiry No. 9146.—Wanted, address of firms engaged in die cast work.

Inquiry No. 9147.—Wanted, manufacturers of machinery for making manilla rope and all kinds of ropes from fibre of century plants, such as maguey, agave, boulken, zaneviera or any such fibres.

Inquiry No. 9148.—Wanted, manufacturers of machinery for weaving bags of fibre, also manufacturers of machinery for separating fibres as above mentioned from their respective plants.

Inquiry No. 9149.—Wanted, manufacturers of machinery for roasting coffee for small and large industries.

Inquiry No. 9150.—Wanted, manufacturers of machinery for the manufacture of French heels for ladies' shoes.

Inquiry No. 9151.—Wanted, manufacturers of cocoanut oil machinery.

Inquiry No. 9152.—Wanted, the address of the Graham Safety Lamp Filler and Ventilator.

(Continued from page 384.)

Motors, cut-off for fluid pressure, J. H. Champ	956,287
Mower, lawn, L. L. Lovett	956,385
Muffler, J. J. Radell	956,170
Music or the like, apparatus for preparing matrix sheets for the reproduction of written, F. Doglibert	956,312
Music playing mechanisms, controller mechanism for automatic, G. S. Williams	956,010
Music rack and cane, combined folding, L. D. Goughenour	956,336
Musical instrument, automatic, J. E. Hagey	955,869
Nest, hen's, A. Jessup	955,886
Nightgown, J. R. Jones	956,102
Nozzle, exhaust or suction, A. T. Noe	955,897
Nut for spindles, split adjusting, F. K. Rand	955,902
Nut, spring, W. C. Schoelkopf	956,185
Oil brazing burner, R. D. Conrad	955,946
Oil engine, crude, J. M. Primm	956,169
Oil refining apparatus, J. C. Fleming	956,065
Ore, treating, Lockwood & Samuel	956,381
Oven, portable baker's, C. E. Sears	955,917
Oyster opener, A. F. W. Diamond	956,049
Package holder, P. R. Parmley	956,157
Package lining, F. S. Davis	956,046
Packeting machine, E. T. Pollard	956,167
Packing, J. Crane	956,042
Packing, hollow shaft, Gray & Kenyon	955,867
Padlock, C. D. Weeks	956,007
Padlock, F. Soley	956,212, 956,213
Paint, O. Marchand	956,389, 956,320
Paint or varnish remover, C. Ellis	956,320
Panel board, L. C. Reed	956,419
Paper bag, H. W. Stuart	955,998
Paper bag holder, P. Joiner	955,883
Paper box, J. G. Reber	956,418
Paper box making appliance, G. N. Coryell	956,486
Paper or like material, apparatus for separating sheets of, F. W. Vickery	956,456
Paper receptacle, J. N. Davis	956,305
Percolator, coffee, C. Fuller	956,332
Percolator pot, valved, J. W. Chapman	956,481
Percussive apparatus, automatic, W. Mauss	955,976
Phonographs, sound amplifier for, V. E. D'Urso	956,235
Photographic print dying apparatus, J. O. Ellingson	956,319
Piano touch regulator, Thompson & Bahr	956,448
Pianos and the like, attachment for, A. D. Palmer	956,502
Pianoforte, C. Vincent	956,003
Picture films, magazine for, G. W. Ryder	956,178
Picture hanger, J. A. Darden	955,854

(Continued on page 386.)

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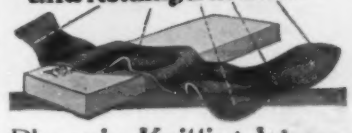

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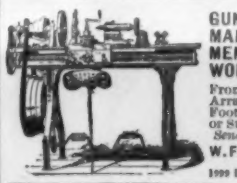

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(Continued from page 385.)

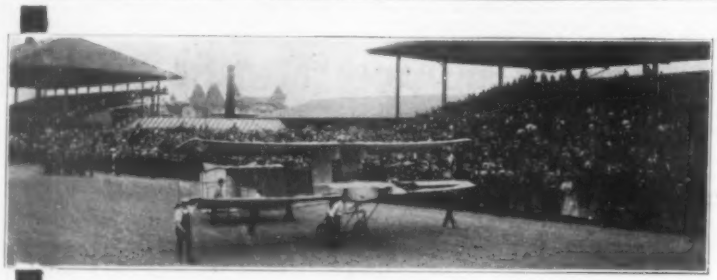
who care to experiment with the eggs of these birds on an ordinary shelf or table. If one sets a fowl's egg rolling on a table, the odds are in favor of its falling to the ground. Not so, however, with the eggs of ledge-frequenting sea-birds. For the forms of these eggs are designed so carefully by Nature, that it is virtually impossible to impart to them any but a circular movement. If disturbed, these eggs roll round and round until the impetus given to them is expended. It is scarcely necessary to dilate upon the importance of this device, inasmuch as such eggs, being laid on the narrow ledges of perpendicular rocks, would—but for their peculiar form—be precipitated into the sea upon the slightest movement of the parent bird. As it is, careful observers have stated that although there is a constant coming and going among the birds, and a constant rotation on the part of the eggs, not one of the latter is dislodged.

The stings and mouth parts of insects typify in many ways the devices and inventions of man. The sting of a bee or a wasp might well have been taken as a model of the modern hypodermic syringe; so, too, might the elaborate arrangement of blades and saws by means of which the female mosquito makes and enlarges her puncture. The instruments, fitted together and working in unison, form a tube through which the insect sucks the blood from her victim and incidentally inoculates him with malarial fever. The several parts of this instrument are shown modeled on a greatly magnified scale in the accompanying photograph. The fact that the sharp blades, tools and saws lie within a sheath when not actually in use is of especial interest, for herein we see typified the sheath or scabbard by means of which mankind protects the keenness of his [illegible] tools and weapons. A still more perfect type of the hypodermic syringe is the fang of a poisonous snake. When the reptile makes its stroke, the base of the fang is driven against a reservoir with the result that the liquid poison is driven through the tubular fang and forced into the wound. Even in the case of large snakes, these deadly weapons are surprisingly slender and delicate, so that the wounds made by them would be quite inconsiderable were it not for the fact that a deadly liquid is injected—exactly as is the case with the hypodermic syringe.

There are many natural devices by means of which plants and animals travel through the air, and mankind is at present engaged in a close study of these with a view to perfecting his own airships and flying machines. The creatures whose appearance and habits resemble balloons most closely are the so-called globe fishes of tropical seas. For the most part their bodies are covered with strong spines, or at least with hard plates; but the strangest characteristic of these ocean dwellers is their power of dilating the gullet with air, when the body swells out into a globe-like form, and the spines are erected, furnishing a formidable protection. When so inflated, globe fish are unable to swim. They drift about upon the surface with the underside turned upward, and skim over the waves, impelled by the passing breeze. It cannot be doubted that this singular habit, reminiscent of the balloon, is beneficial to these fish in that it enables them to escape the onslaught of sharks and allied carnivorous creatures of the deep.

In conclusion, we may glance for a moment at Nature's own electric batteries—two remarkable examples of the capacity of animal structure to produce electricity, to store it so to speak, and to discharge it at will. Both these creatures are fish, one belonging to the eel tribe, the other being a species of ray known as the torpedo fish. As a matter of fact, the torpedo rays belong to several species which are met with in the Atlan-

(Concluded on page 387.)



(Photo. Paul Thompson) Fournier's machine just before a flight at Brighton Beach

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(Continued from page 385.)

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Pipe. See Concrete pipe.
Pipe connection, R. M. Corcoran 956,294
Pipe joint connection, steam, E. C. Colson. 956,290
Pipe system, hydraulic power, C. A. Compton 955,945
Pipe wrench, A. Treand 956,453
Pipes, automatic connector for train, P. Beahm 956,468
Piston, cylinder, E. W. Phillips 956,163
Planetary transmission mechanism, C. F. W. Tabler 956,227
Plaster composition, C. Ellis 955,953
Plow, ditching, D. Dahlstrom 956,299
Plow slide, G. L. Schroeder 956,187
Plunger elevator, F. C. Furlow 955,959
Plunger equalizer, A. M. Coyle 955,852
Pneumatic cleaner, E. A. Laughlin 955,886
Pneumatic drill, S. A. Titus 955,924
Poles, apparatus for preserving wooden, J. T. Logan 956,382
Portable bracket, R. J. Birdwell 956,032
Portable elevator, J. B. Ball 955,936
Potato cleaning and barreling device, Green & McIntosh 956,338
Poultry killing apparatus, M. L. Shortridge. 956,202
Presses and other machines, safety appliance for, J. T. Ronan 956,422
Presses, method of and apparatus for running coagulated lumps or the like from the dies of extrusion, E. Luttmann 956,386
Presser foot, A. Grieb 955,962
Pressure generator, T. Wright 956,405
Printing and cutting machine, L. G. Buck. 956,476
Printing press, A. P. Harland 956,084
Printing press ink supplying means, A. P. Harland 956,083
Printing press inking apparatus, M. A. Droitcour 956,316
Printing presses, throw-off mechanism for, M. A. Droitcour 956,315
Printing purposes, cliche and other surface for, M. Sandmann 955,912
Profiling machine, M. F. Smith 956,209
Pulley, H. J. Gilbert 955,864
Pulley, W. H. F. Raifsnyder 955,994
Pulley, rope, G. G. Donaldson 956,051
Pulp fibers from pigments, size, filled, and other impurities, apparatus for separating, B. W. Petsche 955,990
Pulp fibers from pigments, size, filling, and other impurities, separating, B. W. Petsche 955,898
Pulverizing mill, A. J. Sackett 955,910
Pump, E. Garstenberg 955,960
Pump, oil, E. Woerner 956,016
Pump valve, C. Dickinson 956,050
Pumping apparatus, well, C. M. Hecter 956,346
Punch, plate, A. Koch 956,368
Puzzle, D. E. Smith 956,441
Rack. See Drawing rack.
Radiator foot rail, A. J. Benton 956,029
Rail brace, A. O. Buckius Jr. 956,282
Rail joint, C. F. Wolf 956,014
Rail joint, S. Shuller 956,440
Rail spike, M. Topliff 956,233
Railway frog, J. E. Lewis 955,887
Railway spike, D. M. Lipscomb 956,378
Railway tie, D. R. Will 955,928
Railway tie, F. E. Davidson 956,045
Railway tie plate, A. Morrison 956,398
Razor blade holder, safety, G. M. Atkins 955,935
Receptacle, A. H. S. Swan 956,226
Reel holder, W. McDougall 956,380
Reel holder, J. P. Weaver 956,241, 956,242
Refrigerator, T. Henderson 955,872
Refrigerator, F. E. Ranney 956,415
Refrigerator car, G. C. Bohn ..... [illegible]
Regenerative reversing furnace, L. L. Knox. 956,507
Regulating and reversing apparatus, H. Kopper 956,106
Riveting machine, hydraulic, W. H. Wood. 956,253
Roads, making, L. S. Van Westrum 956,069
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Rock drill, electric, O. S. Proctor 955,899
Rock drill spraying device, W. J. Barnett. 956,026
Roll making machine, H. F. W. Huegg 956,069
Roller bearing wheel, W. J. Brewer 956,279
Roller, bumper, etc., H. F. Pendleton 956,503
Rolling mill, F. H. Daniels 956,301
Roofing plate, Day & Riddle 955,855
Rotary engine, Van Alstyne & Bell 955,925
Rubber, vulcanizing, H. F. Pendleton 956,409
Rudder, S. B. McNeely 956,404
Ruffling and stitching machine, A. H. De Voe 955,951
Ruler and blotter holder, combination, W. E. Jackson 955,879
Running gear, swiveled, H. Higgin 955,873
Safety burner, J. W. Dearing 955,949
Sash lock, window, A. C. J. Roy 956,427
Saw handle, J. Sells 956,196
Saw set, W. H. Swallnston 955,999
Saw set, crescent, F. W. P. Rajala 955,901
Sawing machine, portable, J. H. Longstreet. 955,975
Scaffold, portable, F. Nowodworski 956,406
Scale, weighing, A. W. Epright 956,322
Screen. See Door screen.
Screen, H. W. & W. W. Watson 956,240
Screen, C. E. & W. C. Marsh 956,391
Screw joint outlet, lead calked, J. Douglas. 956,314
Seal lock, A. A. de A. de Castro 956,480
Sealing machine for pasteboard cartons, bottom flap, F. B. Martin 956,392
Sealing machine, tube, T. A. Edison 956,317
Sealing means for registering devices, F. J. Frederick 956,490
Separating device, C. P. Bossart 955,843
Sewing machine, J. Danenmark 956,300
Sewing machine, hemstitch, M. Hemleb 955,963
Sewing machine, shoe, F. J. Nash 955,982
Sewing machine, shoe, E. E. Beau 956,469
Sewing table for bookbinders, G. M. Gaither. 956,333
Shade adjuster, window, L. P. Harris 956,085
Shade ornament and weight, combined window, M. A. Sapp 955,913
Shaft holder, vehicle, Oller & Hill 956,154
Sharpener, scraper, J. E. Hillstrom 956,350
Sharpening, clamping device for holding cutter bars for, A. B. Donaldson 956,313
Sheet metal box, M. Kamenstein 956,362
Shield, chafing, E. Hall 956,341
Ship and ship's hatch, J. R. Oldham 956,152
Shoe, W. Beck 956,271
Shoe calk attachment, A. Roth, Jr. 956,177
Shutter fastener, H. Zimmerman 956,256
Shuttle, J. C. Sergeson 956,198
Shuttle holder, T. Mooney 956,131
Sign, Schaefer & Nance 956,429
Sign, illuminater, R. F. Venner 955,926
Signaling and fire alarm system, watchman's, G. M. Willis 955,929
Signaling by electromagnetic waves, R. A. Fessenden 956,489
Signaling system, automatic electrical, H. M. Eldred 956,057
Signaling system, selective, M. W. Zabel. 956,255
Siphon, C. F. Plunkett 956,411
Skeleton post or tower, E. E. Newman 956,146
Slicer, meat, A. W. Johnson 956,360
Slicing mechanism, J. F. Kohler 956,369
Smoke bell support, H. F. Mechling 956,393
Sod line cutting device, A. E. Heyman 956,091
Soldering iron, L. S. Frost 956,070
Sound recording and reproducing machine, C. E. West, Jr. 956,460
Spanner wrench, G. Amborn 956,259
Speed device, variable, B. D. Stevens 955,920
Spinning or twisting machines, thread board for, E. Whittum 956,248
Spoke socket, C. E. Brown 956,035
Spool, J. D. Chaffee 956,284
Spraying apparatus, W. B. Inglis 956,101
Square holes, device for forming, C. A. Brown 956,474
Stanchion, cattle, A. H. Race 956,413
Station indicator, A. G. Anderson 956,260
Station indicator and advertising device, C. H. Hopkins 956,098
Steam boiler, Lord & Jones 956,383

(Concluded on page 387.)

(Concluded from page 386.)

tic, Mediterranean and Indian Oceans. The broad, smooth body has a rounded outline, and on each side of the head there is an electric organ capable of giving electric shocks. The accompanying illustration shows one of these fish dissected to show the seat of its electric power. On the left, the nerves supplying the organ are dissected away. The prismatic areas on the surface of the organ indicate the vertical columns of electrical plates, of which there may be 500,000 in each organ. The arrangement of these plates, or disks, is like the metallic portions of the voltaic pile, while each is separated from its neighbor by a delicate membrane, which takes the place of the cloth. The object of this electric power on the part of the torpedo ray appears to be to enable the creature to secure its prey either by killing it, or rendering it temporarily insensible. It is said that just before the shock is delivered, the eyes are depressed in the head like those of a toad when swallowing a large insect.

The electric eel of Southern America sometimes attains a length of six feet, and its electric organs are proportionately four times as large as those of the torpedo. When about to deliver its shock it points its body in the direction of the intended victim, stiffens itself, and with a sort of shudder, the electric fluid is emitted. It is said that the fish which is the object of the discharge rarely or never escapes, but simultaneously with the shudder of the eel turns on its back and lies motionless—an easy prey to the electric monster.

It would be possible to dilate at much greater length upon the natural prototypes of human inventions. Enough has been penned, however, to show how frequently man's thoughts reflect the devices which already exist in organic nature. The moral to this should not be far to seek. If so many existing human inventions have been anticipated by Nature, we may conclude that with Nature lie the secrets of inventions yet to come; nor can it be doubted that a close study of animal and plant life will from time to time bear fruit in the form of mechanical devices which will prove of inestimable value to mankind at large. For this reason, if for no other, the inculcation of Nature study in the minds of young people is highly desirable.

THE NICE AVIATION MEET.

(Concluded from page 372.)

made but one stop, at Litchfield. He started readily from that place at 4.09 A. M. and covered the remaining 68 miles in 1 hour and 21 minutes, beating the train that accompanied him. The last 24 miles were flown in 24 minutes on account of a favorable wind. Eight thousand people are reported to have watched him arrive and to have given him a rousing welcome.

Next to the Blériot-Latham race across the English Channel last July, this cross-country flight is the greatest achievement so far in aviation. In the light of what has already been accomplished it would seem that from 800- to 1,000-mile flights without a stop for fuel are now quite possible of accomplishment, the only limiting factor being human endurance. In both his attempts at flying from London to Manchester Grahame White was obliged to give up on account of the great strain undergone by him in maintaining the equilibrium of his biplane in the strong and gusty wind. When some device is provided which will maintain equilibrium automatically, the strain upon the aviator will be greatly relieved and driving an aeroplane will then be no more fatiguing than running an automobile.

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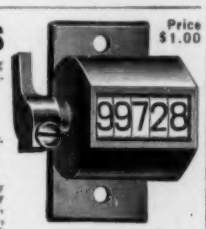

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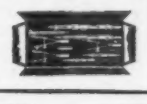

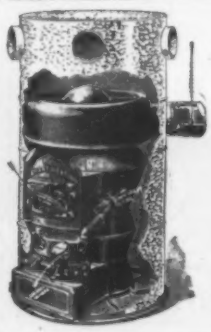

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